Body and Equipment Mounting Manual

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1.1 About this Publication

This Body and Equipment Mounting Manual (BEMM) is the latest publication for the 2015 Transit. It is recommended to review this manual in full. The BEMM is a live document which can be viewed on https://fordbbas.com. It is the Vehicle Modifiers responsibility to review the online version for the most current information prior to starting any conversion.

This BEMM has been updated since the last publication dated 11/2017 for consistency alignment and layout. Also the following section has been updated:

Refer to: 5.12 Roof (page 193).
Roof loads added.

For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com

1.2 About this Manual

1.2.1 Introduction

This manual has been written in a format that is designed to meet the needs of Vehicle Modifiers. The objective is to use common formats with the workshop manual which is used by technicians worldwide.

This guide is published by Ford and provides general descriptions and advice for modifying vehicles.

It must be emphasized that any change to the basic vehicle which does not meet the enclosed guideline standards may severely inhibit the ability of the vehicle to perform its function. Mechanical failures, structure failure, component unreliability or vehicle instability will lead to customer dissatisfaction. Appropriate design and application of body, equipment and or accessories is key to ensuring that customer satisfaction is not adversely affected.

The information contained within this publication takes the form of recommendations to be followed when vehicle modifications are undertaken. It must be remembered that certain modifications may invalidate legal approvals and application for re-certification may be necessary.

Ford cannot guarantee the operation of the vehicle if non-Ford-approved electrical systems are installed. Ford electrical systems are designed and tested to function under operational extremes, and have been subjected to the equivalent of ten years of driving under such conditions.

1.2.2 How to Use This Manual

This manual covers vehicle modification procedures.

The pages at the start of this manual list the content, by group. A group covers a specific portion of the vehicle. The manual is divided into five groups, General Information, Chassis, Powertrain, Electrical and Body. The number of the group is the first number of a section number. Each title listed in the contents links to the relevant section of the manual.

In some section of the book it may refer you to see additional sections for information, links have been provided, these links are in blue text.

This manual is also designed to be used as a printed document, where there are links page numbers in brackets have been added, which will help guide you to the start of the section which contains the relevant information.

There is also an alphabetical index at the back of the manual. As with the contents pages you will be able to link to sections. To do this just click on the page number.

All left and right handed references to the vehicle are taken from a position sitting in the driver seat looking forward unless otherwise stated.

1.2.3 Important Safety Instructions

Appropriate modification procedures are essential for the safe, reliable operation of all vehicles as well as the personal safety of the individual carrying out the work.

This manual cannot possibly anticipate all such variations and provide advice or cautions as to each.

As you read through this manual, you will come across WARNINGS, CAUTIONS and NOTES.

A warning, caution or note is placed at the beginning of a series of steps if it applies to multiple steps. If the warning, caution or note only applies to one step, it is placed at the beginning of the specific step (after the step number).

WARNING: Warnings are used to indicate that failure to follow a procedure correctly may result in death or personal injury.

CAUTION: Cautions are used to indicate that failure to follow a procedure correctly may result in damage to the vehicle or equipment being used.

NOTE: Notes are used to provide additional essential information required to carry out a complete and satisfactory repair.

1.2.4 Supplemental Information

For further information please go to the Body Builders Advisory Service, https://fordbbas.com/, or email bbasqa@ford.com

1.3 Commercial and Legal Aspects

1.3.1 Legal Obligations and Liabilities

The Vehicle Modifier should consult with its legal advisor on any questions concerning its legal obligations and liabilities.

1.3.2 General Product Safety Requirement

The Vehicle Modifier shall ensure that any vehicle it places on the market complies with all F/CMVSS standards.

The Vehicle Modifier shall release Ford from all liability for damages resulting from:

- Failure to comply with these Body Equipment Mounting directives, in particular warnings
- Faulty design, production, installation, assembly or alteration not originally specified by Ford
- Failure to comply with the basic fit for purpose principles inherent in the original product

WARNINGS:

Do not exceed the Gross Vehicle Weight Rating (GVWR), Gross Combination Weight Rating (GCWR), Gross Axle Weight Rating (GAWR), Front Gross Axle Weight Rating (FGAWR), Rear Gross Axle Weight Rating (RGAWR) or trailer ratings.

Do not change the tire size or load rating.

Do not modify the steering system.

Excessive heat can build up from the exhaust system, in particular from the catalytic converter and from the Diesel particulate filter (DPF). Ensure adequate heat shields are maintained. Maintain sufficient clearance to hot parts.

Do not modify or remove heat protection shields.

Do not remove labels provided with the base vehicle. Ensure appropriate visibility.

Do not route any electrical cables with the Anti-lock Brakes System and Traction Control System cables because of extraneous signal risk. It is generally not recommended to hang electrical cables off existing harnesses or pipes.

Do not change original location or remove warning labels provided with the base vehicle in view to the driver. Ensure that labels remain in full view.

NOTE: For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com

Refer to: 1.4 Contact Information (page 9).

1.3.3 Restraints System

WARNINGS:

Modifications to the restraints system are not allowed.

Airbag are explosive. For safe removal and storage during modification follow the procedures in the Ford workshop manual.

Do not alter, modify or relocate the airbag, sensor and modules of the restraints system or any of its components.

Attachments or modifications to the front end or B-Pillar of the vehicle may affect the airbag deployment timing and result in uncontrolled deployment.

For additional information:

Refer to: 5.10 Airbag Supplemental Restraint System (SRS) (page 188).

1.3.4 Drilling and Welding

WARNING: Do not Drill or Weld Boron steel parts, see figures E184299 and E185270 in the welding section of this manual.

Refer to: 5.1 Body (page 155).

Drilling and welding of frames and body structure have to be conducted following the guidelines in Welding and Frame Drilling and Tube Reinforcing sections.

Refer to: 5.14 Frame and Body Mounting (page 197).

1.3.5 Minimum Requirements for Brake System

It is not recommended to modify the brake system. If a special modification should require modifications:

- Maintain original settings
- Maintain brake certification load distribution

Changes to the Anti-lock Brake System (ABS), Traction Control System (TCS) and Electronic Stability Control ESC (also known as ESP) system are not permitted.

1.3.6 Road Safety

The respective instructions should be strictly observed to maintain operational and road safety of the vehicle.

1.4 Contact Information

As a manufacturer, we want to provide you with the information you need for your vehicle modification. If the information you require is not in this manual or you have further questions, please contact Ford Body Builders Advisory Service at https://fordbbas.com, telephone 877-8404338 or email bbasqa@ford.com

1.5 Electromagnetic Compatibility (EMC)

WARNING: Radio Frequency (RF) transmitter equipment (for example: cellular telephones, amateur radio transmitters) may only be fitted to your vehicle if they comply with the parameters shown in the 'Frequency Overview' table and the antennas may only be fitted to positions identified in figure E167532. It is the vehicle modifiers responsibility to make sure that any equipment fitted complies with applicable local legislation. Make sure any equipment is fitted by an authorised dealer.

WARNINGS:

Do not mount any transceiver, microphones, speakers, or any other item in the deployment path of the airbag system.

Do not fasten antenna cables to original vehicle wiring, fuel pipes and brake pipes.

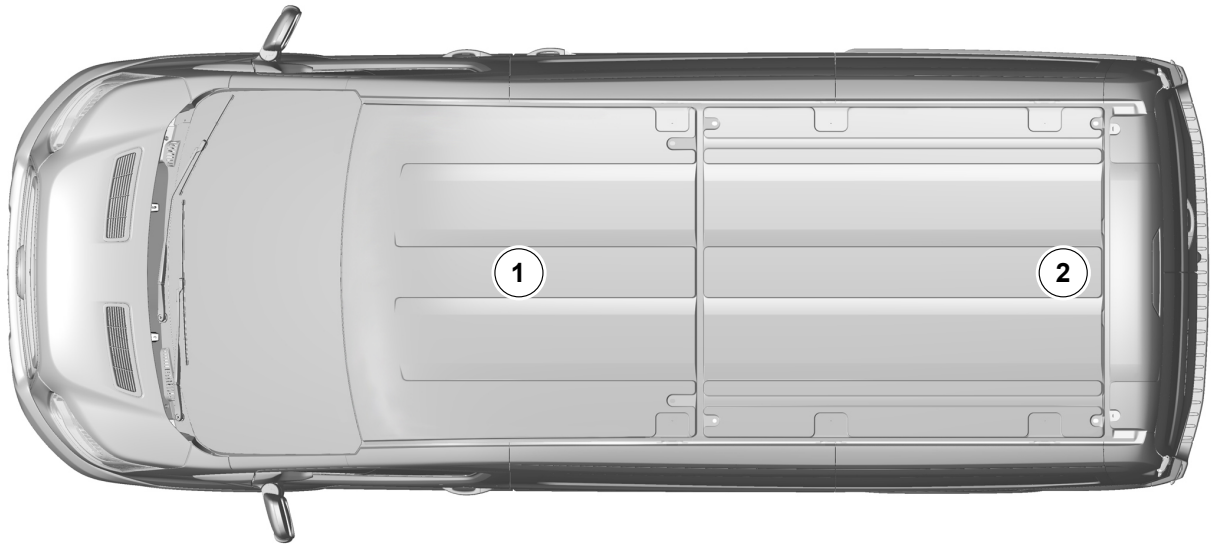
Keep antenna and power cables at least 3.9" (100mm) from any electronic modules and airbags.

NOTE: Only fit the antenna in the positions shown to the roof of your vehicle.

Frequency Overview

Frequency Band MHz	Maximum Output Power Watts (Peak RMS)	Antenna Position
1 - 30	50W	2
30 - 54	50W	1, 2
68 - 87.5	50W	1, 2
142 - 176	50W	1, 2
380 - 512	50W	1, 2
806 - 940	10W	1, 2
1200 - 1400	10W	1, 2
1710 - 1885	10W	1, 2
1885 - 2025	10W	1, 2

1.5.1 Permitted Antenna Locations



E193241

NOTE: After the installation of RF transmitters, check for disturbances from and to all electrical equipment in the vehicle, both in the standby and transmit modes.

Check all electrical equipment:

- With ignition **ON**
- With the engine running
- During a road test at various speeds

Check that electromagnetic fields generated inside the vehicle cabin by the transmitter installed do not exceed the applicable human exposure requirements.

1.6 Vehicle Duty Cycle Guidelines

It is necessary to take into account the customer usage profile and the anticipated vehicle duty cycles of the modified vehicle in order to choose the appropriate specification of the base vehicle.

It is necessary to select the appropriate drive, engine, gear ratio, Gross Vehicle Weight Rating (GVWR), Gross Combination Weight Rating (GCWR), Gross Axle Weight Rating (GAWR), Front Gross Axle Weight Rating (FGAWR), Rear Gross Axle Weight Rating (RGAWR) and payload of the base vehicle to match the customer requirements.

Where possible make sure that the base vehicle is ordered with any necessary plant fit options.

NOTE: For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com

A high numeric gear ratio is recommended for vehicles with customer requirements for:

- High payload
- Trailer tow
- Frequent stop-and-go cycles
- High altitude and gradients
- Terrain conditions such as found on building and construction sites

1.6.1 Modification Affect on Fuel Economy and Performance

Any modification may affect the fuel consumption and performance depending on the aerodynamics and the weight added by the modification. It is advisable to control the weight, but without deteriorating other vehicle attributes and functions (especially those related to safety and durability).

1.6.2 Vehicle Ride and Handling Attributes

CAUTION: Do not exceed the Gross Vehicle Weight Rating (GVWR), Gross Combination Weight Rating (GCWR), Gross Axle Weight Rating (GAWR), Front Gross Axle Weight Rating (FGAWR), Rear Gross Axle Weight Rating (RGAWR) or trailer rating limits.

NOTE: Raising the center of gravity will affect ride and handling.

NOTE: This vehicle should be evaluated for safe operation prior to sale.

1.7 Lifting

WARNING: When lifting the vehicle with a two post lift for the removal of the engine/transmission or rear axle, make sure the vehicle is secured to the lift using vehicle retention straps to prevent tilting. Failure to follow these instructions may result in personal injury.

CAUTIONS:

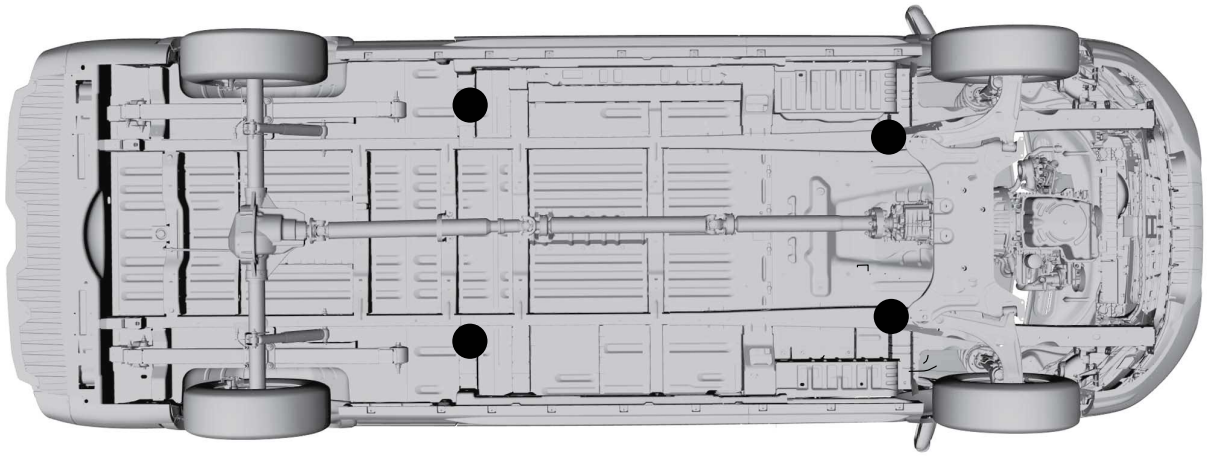
When lifting the vehicle with two post lift, vehicle lift arm adapters must be used under the lifting points.

When lifting the vehicle with a two post lift, the maximum kerb weight must not be exceeded.

It is important that only the correct lifting and support locations are used at all times.

NOTE: For further information refer to the Owner's Manual.

Lifting Points - Van, Wagon



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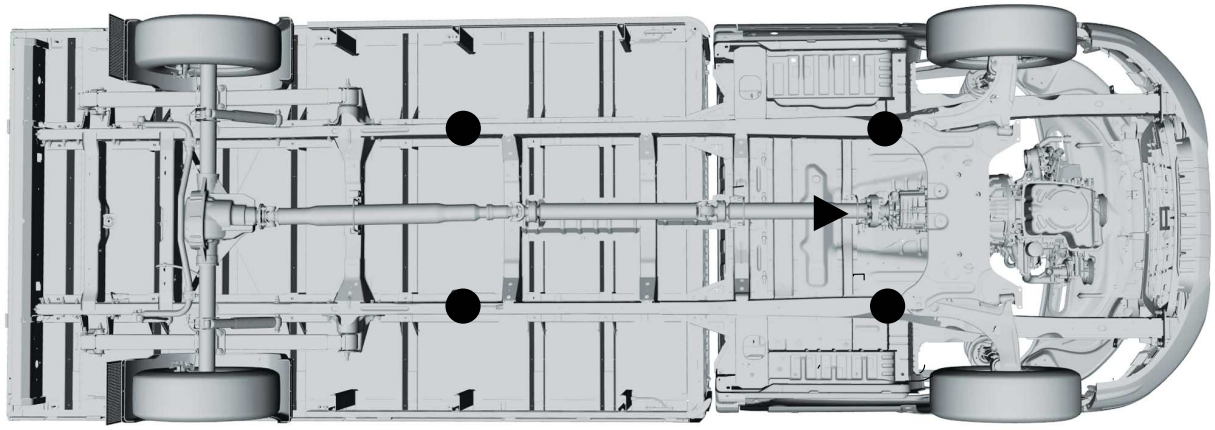
Lifting Points - Chassis Cab/Cutaway



E175928

1.8 Noise, Vibration and Harshness (NVH)

WARNING: Make sure that the modified vehicle complies with all relevant legal requirements.

CAUTION: The travel and function of pedals must not be restricted.

Changes to the powertrain, engine, transmission, exhaust, air intake system or tires may influence the exterior noise emission. Therefore the exterior noise level of the modified vehicle has to be verified.

The interior noise levels should not be deteriorated by the modification. Reinforce panels and structures as appropriate to avoid vibrations. Consider the usage of sound deadening material on panels.

1.9 Vehicle Transportation Aids and Vehicle Storage

CAUTIONS:

Disconnect the battery if the vehicle is to be stored for more than 7 days.

Make sure that the protective covers are not removed from an incomplete vehicle until the modification is started.

Make sure that components removed during modification are kept clean and dry.

Make sure that components removed during modification are refitted to the same vehicle.

In addition:

- The windshield wipers should be lifted off the glass and set right up
- All air intakes should be closed
- Increase normal tire pressure by 7.25Psi
- The hand brake system should not be used
- Apply suitable wheel chock to prevent roll away

A significant risk during storage is deterioration of vehicle bodywork, therefore, appropriate storage procedures must be observed, including periodic inspection and maintenance.

Claims arising from deterioration caused by incorrect storage, maintenance or handling are not the responsibility of Ford.

Vehicle Modifiers must determine their own procedures and precautions, particularly where vehicles are stored in the open as they are exposed to any number of airborne contaminants.

The following may be considered a sensible approach to storage:

Short term storage:

- Wherever possible vehicles should be stored in an enclosed, dry, well-ventilated area based on firm, well drained ground which is free of long grass or weeds and where possible protected from direct sunlight
- Vehicles must not be parked near, under foliage or close to water as additional protection may be necessary for certain areas

Long term storage:

- Battery to be disconnected, but not removed from the vehicle
- The wiper blades should be removed and placed inside the vehicle. Make sure the wiper arms are suitably prevented from resting on the windshield
- Wheel trims (where fitted) removed and stored in the luggage compartment
- Release the parking brake completely. Chock the wheels first if the vehicle is not on level ground
- Set climate controls to the "open" position to provide ventilation, where possible
- Make sure that all windows, doors, hood, lift gate, tailgate, luggage compartment lid, convertible top and roof opening panel are completely closed and the vehicle is locked

The Pre-Delivery Inspection (PDI) is the final opportunity to make sure a battery is fit for purpose prior the customer taking delivery of their new vehicle. The battery must be checked and appropriate action taken prior to the vehicle being handed over to the customer. Test results must be recorded on the PDI repair order.

Batteries. To make sure the battery is maintained correctly and to assist in preventing premature failure, it is necessary to check and recharge the battery regularly while a vehicle is not in use. Where a battery is left below its optimum charge level for any length of time, it may result in premature failure of the battery.

Action / Time in Storage	Monthly	Every 3 Months
Check Vehicle is clean	X	-
Remove external contamination	X	-
Check battery condition — Recharge if necessary	X	-
Visually check tires	X	-
Check interior for condensation	-	X
Run engine for 5 minutes minimum with air conditioning switched on, where applicable	-	X

Refer to: 4.4 Battery and Cables (page 72).

1.10 Package and Ergonomics

1.10.1 General Component Package Guidelines

WARNING: Do not modify, drill, cut or weld any suspension components, specifically the steering gear system, subframe or anti-roll bars, springs or shock absorbers including mounting brackets.

The Vehicle Modifier has to ensure that sufficient clearance is maintained under all drive conditions to moving components such as axles, fans, steering, brake system etc.

The Vehicle Modifier is responsible for all installed components during the modification. The durability has to be confirmed by appropriate test procedures.

1.10.2 Driver Reach Zones

Controls and/or equipment required to be used while driving should be located within easy reach of the driver so as not to impair driver control.

1.10.3 Driver Field of View

WARNING: Make sure that the modified vehicle complies with all relevant legal requirements.

1.10.4 Modification Affects on Parking Aids

WARNING: Ensure that monitors mounted in the cabin meet the interior package and safety requirements.

On modifications requiring a rear camera, the reverse signal may be taken as described in the electrical section, described in reversing lamps.

Refer to: 4.12 Exterior Lighting (page 111).

1.10.5 Aids for Vehicle Entry and Exit

Grab Handles

WARNING: Make sure that the location of the no-drill zones are checked before drilling.

CAUTION: Make sure that reinforcements are installed to maintain the integrity of the original body structure.

1.10.6 Vehicle Dimensions

Depending on the body style, Transit is available in 3 Wheelbases and 3 Roof Heights

Wheelbases:

- Regular Wheelbase
- Long Wheelbase
- Extended-Length Long Wheelbase

Roof Heights:

- Low
- Medium
- High

For further information please go to the Body Builders Advisory Service, https://fordbbas.com/topics/2015/2015Transit_techspecs.pdf (Dimensions and Capacities)

1.10.7 Chassis Cab Body

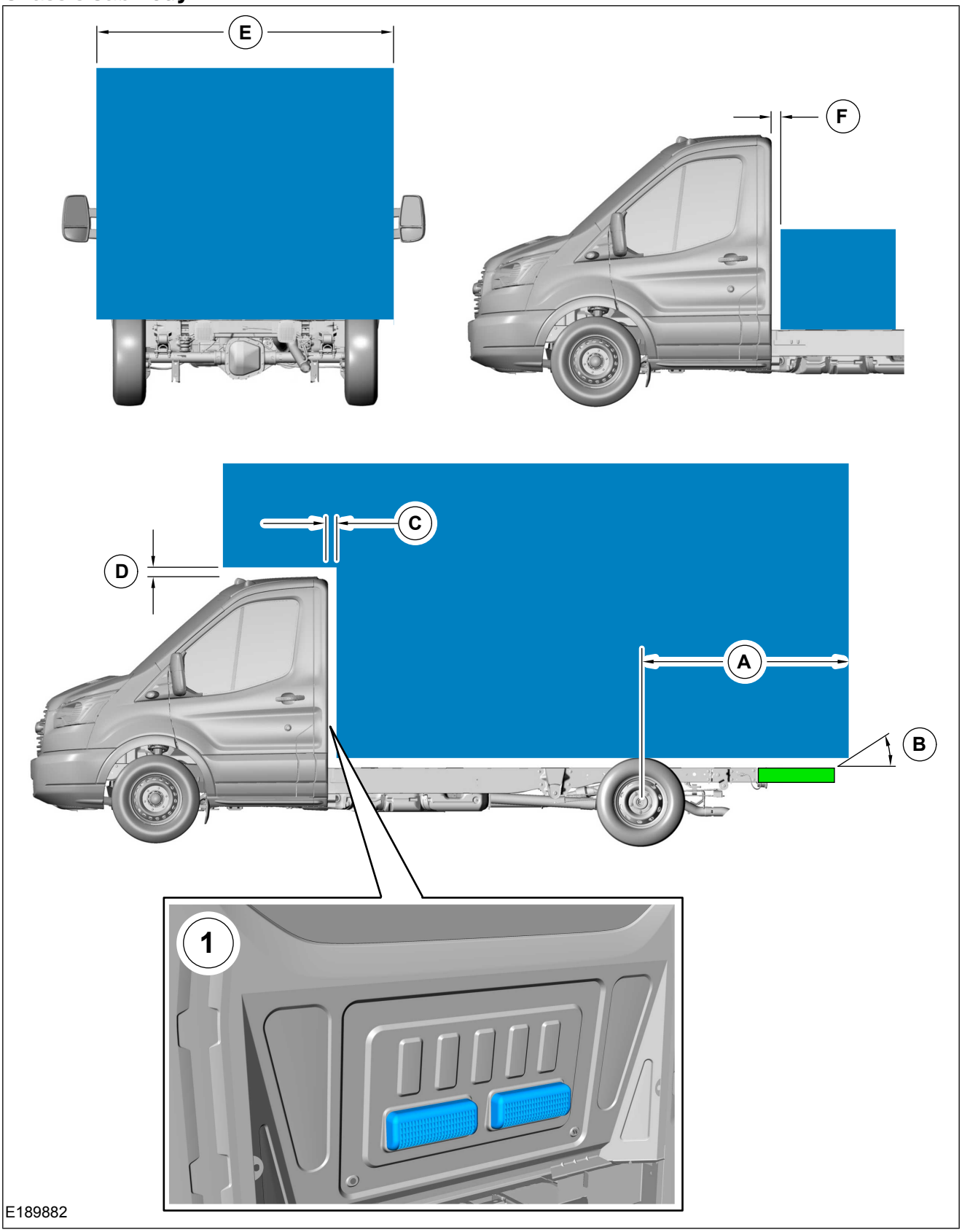
WARNINGS:

Do not modify the wheelbase.

Do not allow Center of Gravity of the body payload to fall behind the rear axle center line.

NOTE: Extreme rear overhang may encourage unacceptable loading conditions, which could unload the front axle producing unacceptable handling and braking characteristics.

Chassis Cab Body



Rear Frame Extensions

Description		RWB -138" (3505mm)	LWB -156" (3962mm)	EL-LWB - 178" (4521mm)
Maximum Rear Frame Extension		30" (762mm)	50" (1270mm)	80" (2032mm)[1]
Rear axle to end of frame, not including frame adapter		37.35" (948.8mm)		
A	Maximum recommended rear overhang[1] considering CoG of body and payload is not rearwards of the rear axle centerline and requirements of masses and dimensions regulation.	67.35" (1710.8mm)	87.35" (2218.8mm)	117.35" (2980.8mm)
B	Ensure local lighting legislation is maintained (F/CMVSS 108)[2]			
C	1.18" (30mm) minimum clearance between the back of the cab and the second unit body			
D	1.18" (30mm)			
E	Maximum external body width[1]	Short Arm Mirrors - 86" (2185mm)[2]		
		Long Arm Mirrors - 96" (2439mm)[2]		

RWB = Regular Wheelbase, LWB = Long Wheelbase, EL-LWB = Extended-Length Long Wheelbase, CoG = Center of Gravity

[1]= > 60" (1524mm) extensions require additional cross members.

[2]= Vehicle Modifiers must ensure that unique second unit body upfits comply with the appropriate F/CMVSS and emissions requirements as specified in the IVM manual.

Refer to: 5.14 Frame and Body Mounting (page 197).

All drag reduction devices that the second unit body vehicle modifiers add should not exceed the maximum frontal area and width as specified in the Incomplete Vehicle Manual.

Maximum Frontal Area (width x height) - NOT to exceed (Emissions Requirement)

Engine	Cab	Max Frontal Area (ft^2)
3.7L TiVCT FFV	SRW Chassis Cab/Cutaway	55
3.7L TiVCT Gasoline	DRW Chassis Cab/Cutaway (less than or equal to 10,000lb GVWR)	60
3.7L TiVCT Gasoline	DRW Chassis Cab/Cutaway (greater than 10,000lb GVWR)	66
3.2L Diesel	SRW/DRW Chassis Cab/Cutaway (less than or equal to 10,000lb GVWR)	60
3.2L Diesel	DRW Chassis Cab/Cutaway (greater than 10,000lb GVWR)	72

1.11 Hardware

Standard Hardware and Tightening Torques (Nm) Bolts/Studs: ISO 898-1, Nuts: ISO 898-2				
Thread Size	**Grade 8.8**		**Grade 10.9**	
	Minimum	**Maximum**	**Minimum**	**Maximum**
M5	5.2	7.2	5.9	8.1
M6	8.9	12.1	10.2	13.8
M8	21.2	28.8	25.5	34.5
M10	40.3	54.7	53.1	71.9
M12	68.0	92.0	93.5	126.5
M14	113	153	148.7	201.3
M16	170.0	230.0	233.7	316.3

This torque chart is a recommendation and the modifier is responsible for the optimal torque for a specific joint.

1.12 Load Distribution

1.12.1 Load Distribution

WARNINGS:

Overloading of the vehicle could result in unacceptable ground clearance.

The center of mass of the payload should be located within the wheelbase of the vehicle.

Avoid one-sided load distribution.

Uneven load distribution could result in unacceptable handling and braking characteristics.

Load distribution outside of the permitted range may result in unacceptable steering, handling and braking characteristics.

CAUTIONS:

Do not exceed the axle plated weights.

Do not exceed the gross vehicle weight.

In rear wheel drive (RWD) single rear wheel (SRW) vehicles, the front axle load must, in all load cases, exceed 36% of the actual gross vehicle weight.

In RWD dual rear wheel (DRW) vehicles, the front axle load must, in all load cases, exceed 30% of the actual gross vehicle weight.

1.12.2 Center of Gravity Position

The position of the center of gravity is changed when masses are added or removed from the vehicle. This may influence the steering characteristics, handling behavior and the brake performance.

Do not raise the center of gravity beyond specified limits or the vehicle may become unstable and dangerous.

Lateral Position

It is important to keep the Center of Gravity laterally within given limits.

Lateral Center of Gravity is determined by the vertical wheel forces difference right (front right mass added to rear right mass) to left (front left mass added to rear left mass).

For any lateral position information please refer to the IVM.

Vertical Position - Center of Gravity Height

The Center of Gravity Height of the vehicle is determined by the mass of the base delivered vehicle and the added and removed masses. In physics this relation is described by the Steiner's theorem.

The Center of Gravity Height influences axle weights while braking. Center of Gravity height influences roll stability.

1.12.3 Center of Gravity Height Test Procedure

Measurement

Vehicle Center of Gravity calculation is required to determine compliance with F/CMVSS 105 Brakes and F/CMVSS 126 Electronic Stability Control. Maximum allowable Vertical Center of Gravity values for these standards can be found in the Incomplete Vehicle Manual: www.fleet.ford.com/truckbbas

In order to check the center of gravity height the following described method is proposed.

For this test four scales are required. The test is possible with two scales but this requires more preparation and it results in lower accuracy.

Initially the vehicle weights needs to be measured in a horizontal position. Afterwards the front is lifted and weights measured again. The higher it is lifted the more accurate the results will be. The height is restricted by different possible touch conditions, between vehicle parts and roof, ground and environment.

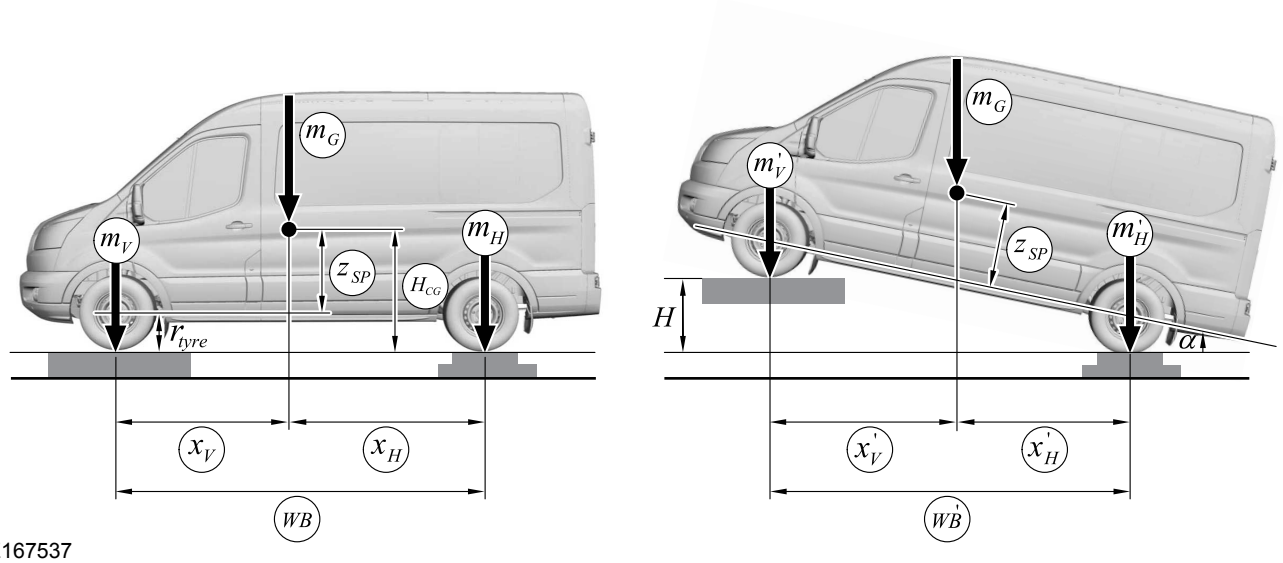
In order to improve measurements following preparations need to be done:

- Fix wheel travel, for example: solid shocks, or spring fixes
- Increase tire pressure to maximum allowed value
- It is important to remove all load, for example moving items, from the car or it should be properly fixed
- Doors should be closed

Before measuring the vehicle the engine must be switched off, after lifting it should be rolled freely in order to release tension in the tire and suspension.

Calculation

In order to estimate the resulting vertical center of gravity (CG_V) the axle load needs to be measured twice. First one is in the horizontal plane and the second measurement is after the front is lifted. To get a consistent result this test should be done 3 times independently with different heights. To improve accuracy the test is repeated with the rear end lifted.



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Variables, to be measured, calculated or known			Measurement		
			1st	2nd	3rd
Wheelbase	WB	mm			
Front Axle Weight	m_V	kg			
Rear Axle Weight	m_H	kg			
Total Mass	$m_G = m_V + m_H$	kg			
INCLINED VEHICLE					
Front Axle Weight	m'_V	kg			
Rear Axle Weight	m'_H	kg			
Height (Lift)	H	mm			
Inclination Angle - see figure E146623		deg			
Center of Gravity Height Z - see figure E146624		mm			

Inclination Angle:

$$\alpha = \arcsin\left[\frac{H}{WB}\right].$$

E146623

Center of Gravity Height Z:

$$z_{SP} = \frac{m_H - m'_H}{m_G \cdot H} \cdot WB^2 \cdot \cos\alpha$$

$$z = H_{CG} = z_{SP} + r_{tyre}$$

E146624

1.12.4 Center of Gravity Height Calculation

Given or measured parameter	
Wheelbase	WB
Front axle weight	m_V
Rear axle weight	m_H
Front height	H

Calculated and auxiliary parameter	
Center of Gravity (CoG) height	Z_{SP}
Total vehicle mass	m_G
Distance front axle to CoG (horizontal)	X_V
Distance rear axle to CoG (horizontal)	X_H
Wheelbase (projected in horizontal)	WB'
Front axle weight	m'_V
Rear axle weight	m'_H
Distance front axle to CoG (projected in horizontal direction)	X'_V
Distance rear axle to CoG (projected in horizontal direction)	X'_H
Inclination angle	arc sin
Front part of 'distance rear axle to CoG (horizontal)'	X_{H1}
Rear part of 'distance rear axle to CoG (horizontal)'	X_{H2}

1.12.5 Formulas

- Masses and lengths. Total vehicle mass is the sum of front and rear axle weight:
- $m_G = m_V + m_H$

The longitudinal distances between the Center of Gravity and the centres of wheels equal:

$$x_V = \frac{m_H}{m_G} WB$$

$$x_H = \frac{m_V}{m_G} WB$$

E146626

In inclined system the main variable is the inclination angle which is the quotient of the lifting height and the wheelbase:

$$\sin \alpha = \frac{H}{WB}$$

E146627

Similar to the equation for the horizontal system the distance projected in to the ground plane can be determined using the sum of moments around front and rear wheel center:

$$x_V' = \frac{m_H'}{m_G} WB'$$

$$x_H' = \frac{m_V'}{m_G} WB'$$

E146628

The following equations apply:

$$WB' = WB \cos\alpha$$

$$x_{H2} = \frac{x_H'}{\cos\alpha}$$

$$x_{H1} = x_H - x_{H2}$$

E146629

Using the rule of proportion leads to the Center of Gravity height formula:

$$\frac{x_{H1}}{z_{SP}} = \frac{H}{WB'}$$

$$z_{SP} = \frac{m_V - m_V'}{m_G \cdot H} \cdot WB^2 \cdot \cos\alpha \quad , \quad \alpha = \arcsin\left[\frac{H}{WB}\right]$$

or

$$z_{SP} = \frac{m_H' - m_H}{m_G \cdot H} \cdot WB^2 \cdot \cos\alpha \quad , \quad \alpha = \arcsin\left[\frac{H}{WB}\right]$$

E146630

1.13 Towing

If planning to retrofit a Tow Hitch to extended wheel base vans and wagons, ensure Trailer Wiring Prep Pack (order code 59B) is ordered on the vehicle.

NOTE: Wiring Prep Pack (59B) only guarantees support for trailer lighting.

NOTE: If trailer brake functionality is required order Trailer Brake Controller (67D). Heavy Duty Trailer Tow (53B) provides connector in instrument panel for add on trailer brake controller.

NOTE: See Trailer Brake Controller (67D) for requirements necessary for addition of trailer lighting capability on capable vehicles.

NOTE: There is no wiring provisions for Trailer Tow operations provided on the base vehicle.

For additional details regarding coponents necessary for the addition of trailer lighting capability on capable vehicles

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).
Electrics for Tow Bar section.

NOTE: Tow Haul Mode is only available when ordering Trailer Tow packages 59B or 53B

For availability please contact your National Sales Company representative, or local Ford dealer. If they are unable to help you then please contact the Vehicle Converter Advisory Service at VCAS@ford.com

2.1 Suspension System

WARNINGS:

Do not modify, drill, cut or weld any suspension components, specifically the steering gear system, subframe or anti-roll bars, springs or shock absorbers including mounting brackets.

Interchangeability (between different Transit variants) of springs, shock absorbers and jounce bumpers is not permitted as the changes in vehicle dynamic performance can affect the ESP system.

CAUTION: Modifications to the suspension system can cause a deterioration of the vehicle handling characteristics and durability.

NOTE: For further information please contact the Body Builders Advisory Service at bbas@ford.com

2.2 Front Suspension

2.2.1 Springs and Spring Mounting

WARNINGS:

Do not modify, drill, cut or weld any suspension components, specifically the steering gear system, subframe or anti-roll bars, springs or shock absorbers including mounting brackets.

Interchangeability (between different Transit variants) of springs, shock absorbers and jounce bumpers is not permitted as the changes in vehicle dynamic performance can affect the ESP system.

CAUTIONS:

When carrying out welding work the springs must be covered to protect them against weld splatter.

Do not touch springs with welding electrodes or welding tongs.

Make sure that components loosened or removed and reinstalled are properly reassembled and the torque set in accordance with manufactures requirements.

NOTE: Do not modify the wheelbase.

NOTE: Do not damage the surface or corrosion protection of the spring during disassembly and installation.

NOTE: For further information please contact the Body Builders Advisory Service at bbas@ford.com

2.3 Rear Suspension

2.3.1 Springs and Spring Mounting

WARNINGS:

Do not modify, drill, cut or weld any suspension components, specifically the steering gear system, sub-frame, springs or shock absorbers including mounting brackets.

The rear leaf springs are pre-stressed in manufacture and should not be altered for rate or height in any way during vehicle conversion. Adding or removing leaves may result in failure or reduced function of the spring as well as other vehicle related issues for which Ford Motor Company can not be held responsible.

Interchangeability (between different Transit variants) of springs, shock absorbers and jounce bumpers is not permitted as the changes in vehicle dynamic performance can affect the ESP system.

CAUTIONS:

When carrying out welding work the springs must be covered to protect them against weld splatter.

Do not touch springs with welding electrodes or welding tongs.

Make sure that components loosened or removed and reinstalled are properly reassembled and the torque set in accordance with manufactures requirements.

NOTE: Do not modify the wheelbase.

NOTE: Do not damage the surface or corrosion protection of the spring during disassembly and installation.

NOTE: Do not add any additional axles.

NOTE: For further information please contact the Body Builders Advisory Service at bbas@ford.com

Rear Anti Roll Bar

The following vehicles have rear anti roll bars:

- Single rear wheel (SRW) long wheelbase Wagon.
- All dual rear wheel (DRW) vehicles.

2.4 Wheels and Tires

2.4.1 Wheel Clearance

The distance from the tire to the mudguard or wheel arch must be sufficient, even if snow or anti-skid chains are fitted and the suspension is fully compressed allowing for axle twist as well.

NOTE: Make sure that only approved wheels and /or permissible tire sizes are fitted.

NOTE: Ensure access to the wheel and wheel jack, and provide sufficient clearance in wheel arch to allow changing the wheels after modification.

NOTE: Maintain access to the spare wheel winch on Chassis Cab/Cutaway, via the hole in the side rail, under all loading conditions.

For standard wheelhouse dimensions:

Refer to: 5.1 Body (page 155).
(Integral Bodies and Modications)

2.4.2 Tire Pressure Monitoring Sensor (TPMS)

Ford TPMS is a direct system, using physical pressure sensors. TPMS is calibrated according to the correct tire pressure for the GVWR of the vehicle. If the spare wheel is ordered on a base vehicle with TPMS, the tire will not be supplied with a TPMS sensor.

If you need to replace a road wheel and tire with the temporary spare wheel, the system will continue to identify a defect. This is to remind you to repair and refit the damaged road wheel and tire to your vehicle. To restore the correct operation of the system, you must have the repaired road wheel and tire refitted to the vehicle.

NOTE: If fitting new tires, ensure that the TPMS Sensors are fitted correctly. For further information refer to the Owner's Manual, Ford Shop Manual or contact your Local Ford Dealer.

If fitting new tires, you must ensure that the TPMS sensors are fitted correctly as outlined in the service literature.

The TPMS receiver is located in the overhead shelf and points directly towards the rear doors. For additional information

Refer to: 4.15 Handles, Locks, Latches and Entry Systems (page 121).

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2.4.3 Spare Wheel

When modifying or relocating the spare wheel, access must be ensured.

2.4.4 Painting Road Wheels

CAUTION: Do not paint wheel clamp surfaces in contact with other wheels, brake drum or disc, hub and holes, or surfaces under wheel nuts. Any further treatment in these areas may affect the wheel clamp performance and the vehicle safety.

- Mask the wheel when changing the color or repairing paint.

2.5 Brake System

2.5.1 General

The Brake System must be fully functional when the vehicle modification is completed. The vehicle brake operating modes must be checked, including warning system and parking brakes.

Brakes are certified to F/CMVSS 105 on completed vehicles. Guidance for complying with F/CMVSS 105 on incomplete vehicles is provided in the Incomplete Vehicle Manual.

WARNING: Do not restrict the airflow and cooling to the brake system.

CAUTION: Spoilers and wheel covers must not affect the brake cooling performance.

NOTE: Do not obstruct the view of the brake fluid reservoir level.

NOTE: The donor vehicle brake fluid reservoir is translucent so that it is possible to check the level of fluid without opening the reservoir which will reduce the risk of contamination. Do not move brake fluid reservoir.

The brake fluid reservoir must remain accessible for servicing and for adding brake fluid.

2.5.2 Brake Hoses General

CAUTION: Make sure that the front and rear brake hoses are not twisted and are correctly located away from body and chassis components.

Front and rear brake hoses must not rub, chafe or rest on body or chassis components. There must be clearance under all operating conditions, between full compression and extension and full lock to lock.

Brake lines must not be used to support or secure any other component.

2.5.3 Parking Brake

WARNINGS:

Do not modify the brakes.

Do not splice into the parking brake cable.

2.5.4 Hydraulic Brake—Front and Rear Brakes

WARNINGS:

Do not modify the brakes.

Do not modify the disc in flow and out flow of cooling air.

2.5.5 Anti-Lock Control — Stability Assist

WARNING: Do not modify any part of the braking system, including Anti-Lock Brake System (ABS), Traction Control System (TCS) and Electronic Stability Control (ESC), also known as Electronic Stability Program (ESP).

NOTE: For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com

3.1 Engine

CAUTION: Make sure to follow the equipment suppliers instructions for safety, warranty and sometimes legal compliance.

For electrical supply to auxiliary equipment.

Refer to: 4.3 Charging System (page 67).

3.1.1 Engine Selection for Modifications

For CNG/LPG Fuel System Modifications refer to the appropriate QVM Bulletin at https://fordbbas.com/topics/qvmp.html

3.1.2 Engine Types

RWD Common Rail 3.2L TDCi Diesel Engine

Item	Description
Max Power HP/rpm	185 HP @ 3000 rpm
Max Torque lb-ft/rpm	350 lb-ft @ 1750 rpm

RWD 3.5L GTDI Gasoline Engine

Item	Description
Max Power HP/rpm	310 HP @ 5500 rpm
Max Torque lb-ft/rpm	400 lb-ft @ 2500 rpm

RWD 3.7L Ti-VCT Gasoline Engine

Item	Description
Max Power HP/rpm	275 HP @ 6000 rpm
Max Torque lb-ft/rpm	260 lb-ft @ 4250 rpm

3.2.1 Auxiliary Heater Systems

WARNINGS:

Ford coolant additives are necessary for the complete function of the system. Only use Ford approved or equivalent specification component, to withstand any detrimental effects on the materials.

Do not mount components in front of the grille or in an area of air flow around the engine, which could affect the engine cooling.

CAUTIONS:

Only make connections into the heater hose between the front cab heater and water pump return inlet.

Do not exceed the vehicle's original coolant volume (without prep. pack and auxiliary heater) by more than 10%.

Maintain a coolant level between maximum and minimum line in cold condition after fill and de-aerating operations.

Only use the manufacturer recommended (or equivalent specification) coolant additives/anti-freeze. Do not mix coolant types.

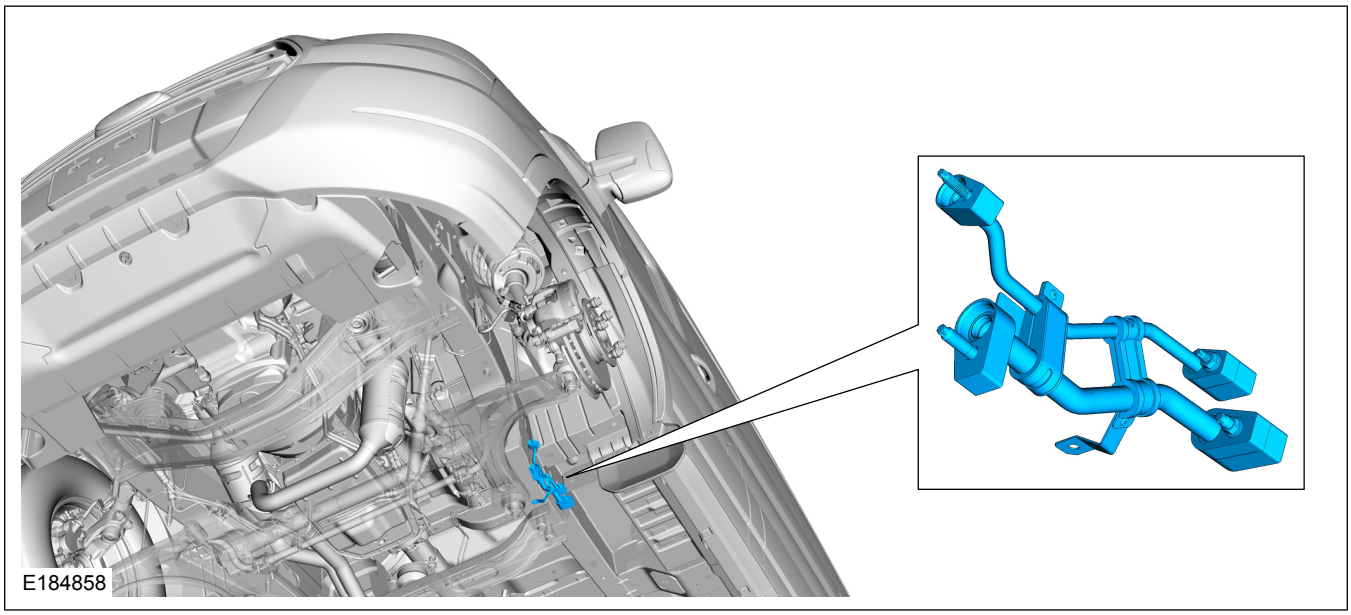
- Coolant flow to cab heater must have priority over flow to auxiliary heater or hand wash facility
- Coolant tube routing must be below the minimum line of the degas bottle
- Tube routing must be secured to the body structure or suitable brackets avoiding electrical components or wires, hot or moving parts and brake or fuel system components
- Hose must be heat sleeved with appropriate material if within 3.9" (100mm) of exhaust components (for example, manifold or exhaust gas recirculating)
- The vertical clearance between the critical cooling components (radiator, fan shroud and radiator brackets) and both the hood inner and outer (assembly) panels at design position shall not be less than 0.6" (15mm)
- There shall be a minimum clearance of 0.4" (10mm) between the engine assembly and flexible components (for example, hoses or wiring harnesses) affixed to front end sheet metal hardware, under a maximum engine torque roll condition

For auxiliary heater and A/C installation use climate control prep-pack. The prep-pack is available for Van/Wagon Prep and Cutaway vehicles.

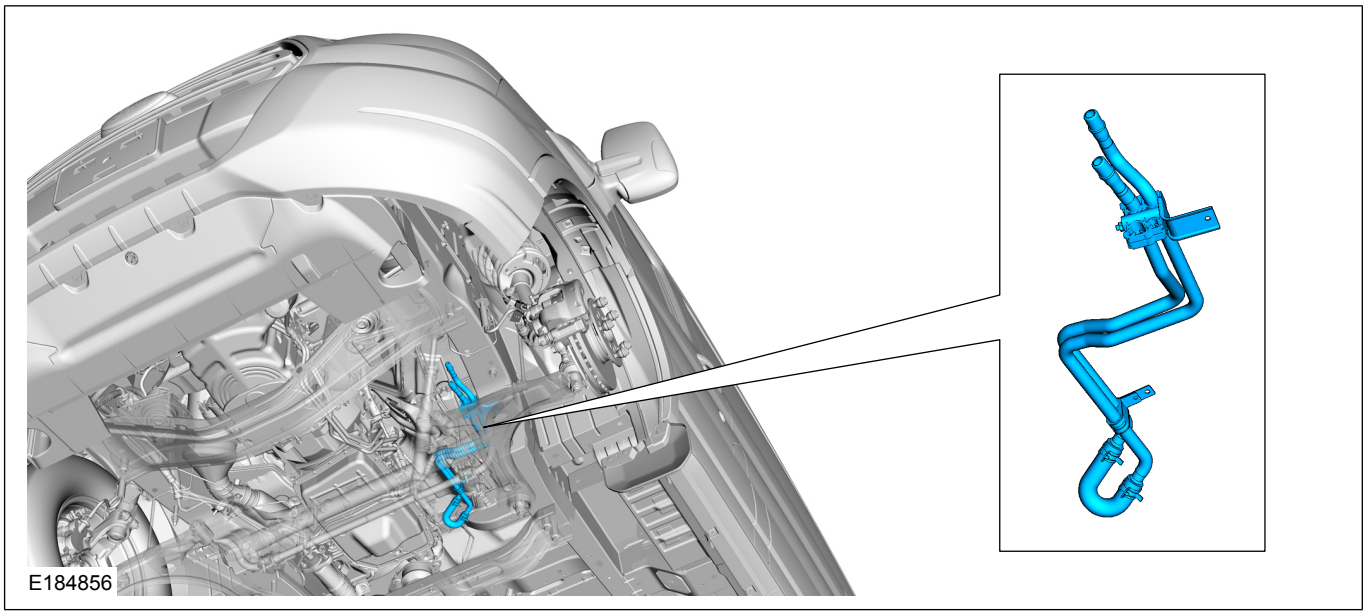
Base Package (62C)

- A/C refrigerant line prep lines
- Heater prep lines

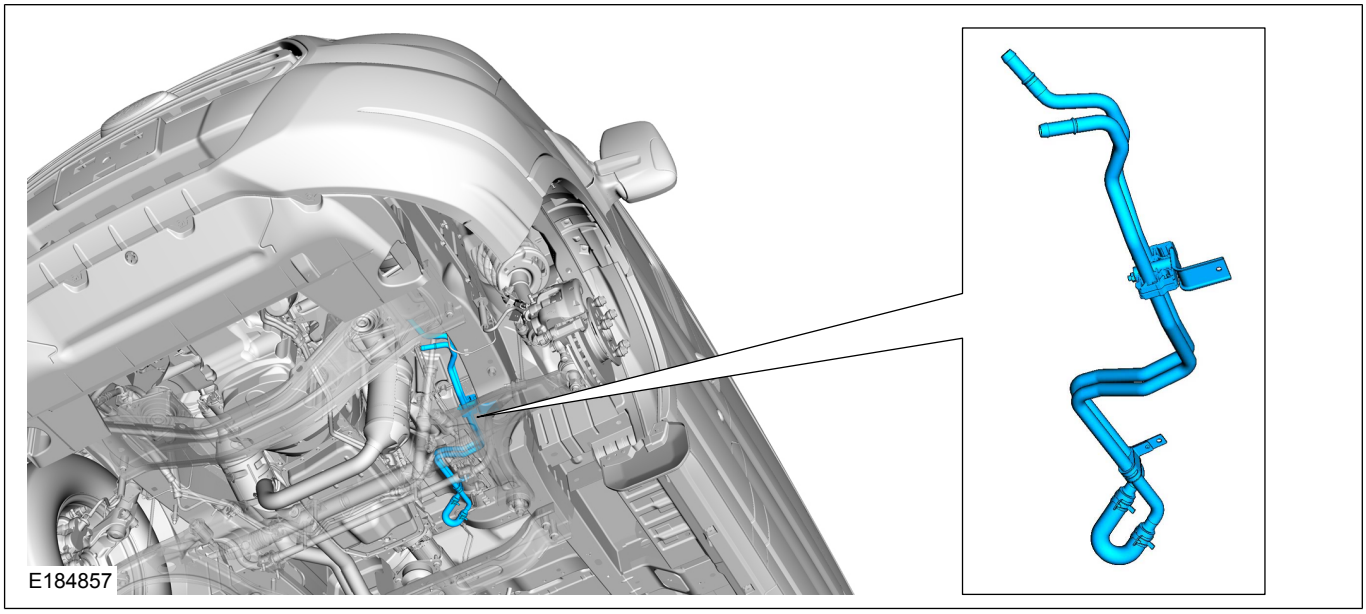
Common A/C Prep-Pack



Diesel Heater Prep-Pack



Gasoline Heater Prep-Pack



For prep-pack connections see Workshop Manual

Connecting to the OEM A/C System

- A/C taps are located beneath the drivers side 'B' Pillar
- Recover R-134a and measure any oil removed
- Remove metal seal fitting blank and replace with female metal seal fitting
- Replace rubber seals for any metal seal fitting being serviced
- Complete addition of auxiliary system
- Charge system and replace the oil

Connecting to the OEM Heater System

- Clamp the heater lines upstream of the prep-pack system
- Remove 180° U-Bend and restriction from the end of the prep-pack lines by removing the tension clamps
- U-Bend contains a restriction to prevent loss of coolant flow to the front HVAC
  - the bottom, car rearward coolant line supplies the hot coolant
- Complete addition of the auxiliary heater system
- Replace 50/50 coolant and water mixture
- De-aerate coolant systems as per Workshop Manual

Aftermarket Rear Auxiliary A/C and Rear Heater Guidelines

A/C System

- The auxiliary system must use a TXV expansion system and must be properly sized to maximize performance
- Refrigerant shut off valves are not recommended

Heater System

- Coolant temperature must be able to maintain 158ºF (70ºC) throughout normal operation

A/C Prep-Pack Constraints

- Do not operate the A/C compressor prior to the installation of an auxiliary unit. This will cause oil to accumulate in the prep-pack lines and starve the compressor of oil
- Keep maximum defrost use to a minimum as this also uses the compressor to de-humidify the air

3.2.2 Auxiliary Heater Installation

Ensure that the exhaust gas from any auxiliary heating system can not be re-circulated into the vehicle. The exhaust gases must not pass into the engine intake system or the air intake for the passenger compartment ventilation. The heating system should be installed outside the passenger compartment. The location of the heating system should not be in close proximity to movable components. Any body reworks which damage the paint must be fully protected against corrosion.

Refer to: 5.13 Corrosion Prevention (page 196).

NOTE: The installation must be in line with the appropriate legal requirements.

3.2.3 Air Flow Restrictions

WARNING: Do not mount components in front of the grille or in an area of air flow around the engine, which could affect the engine cooling performance.

CAUTION: Over heating within the engine compartment can seriously compromise component robustness.

NOTE: Please assume under hood environment is about 266ºF (130ºC) when selecting appropriate materials

NOTE: For further information please contact the Body Builders Advisory Service at www.fleet.ford.com/trackbbas

3.3 Accessory Drive

3.3.1 Front End Accessory Drives (FEAD)— General Information

When the correct belt is used, tensioning is and remains fully automatic for the life of the belt.

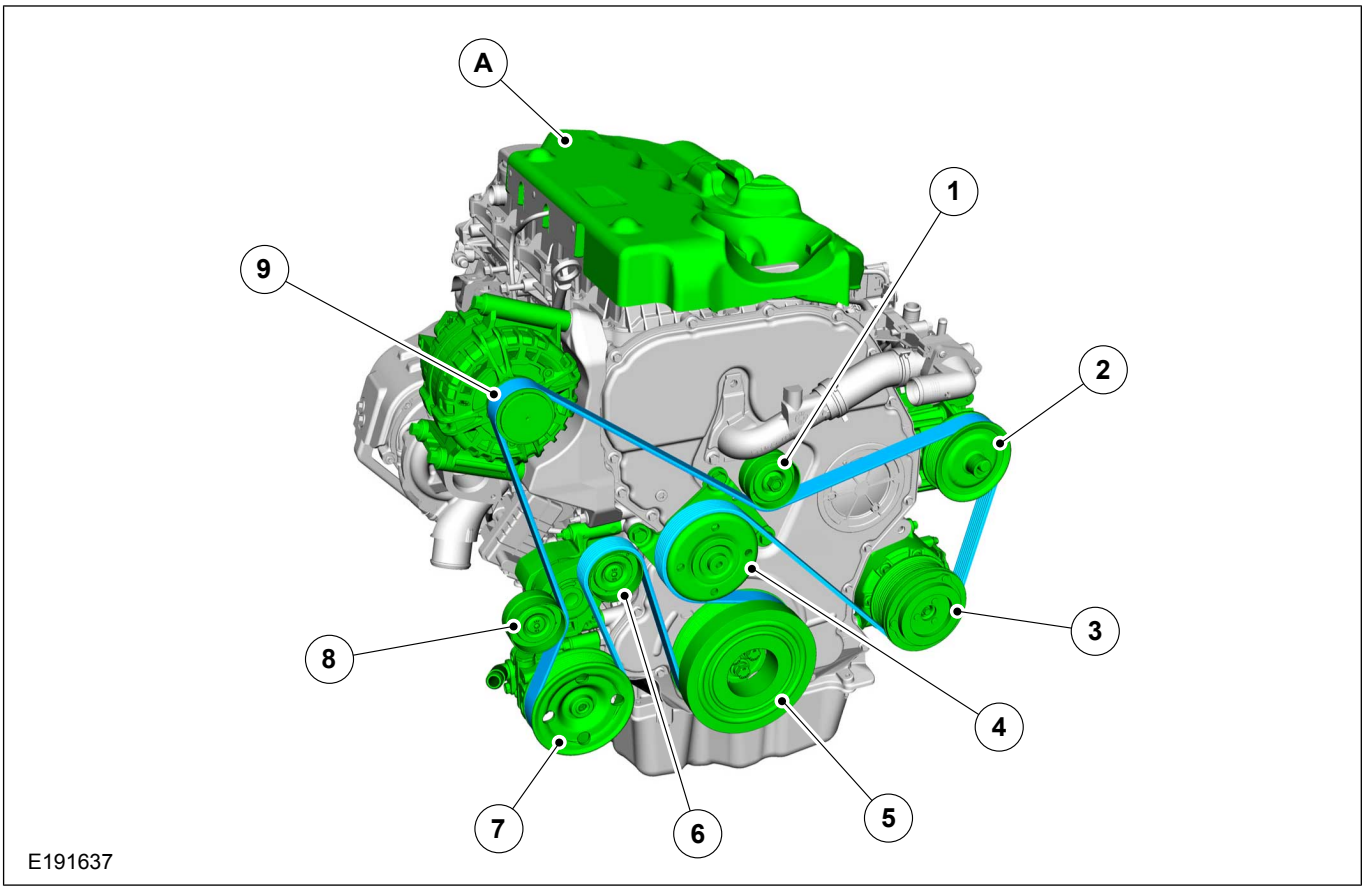
CAUTIONS:

- **Only use the manufacturers recommended (or equivalent specification) components.**
- **Make sure that the ancillary pulley diameter is less than the crankshaft pulley diameter.**
- **Front End Accessory Drive shields must be maintained at all times. If shields are removed, for example when attaching an ancillary unit, they must be replaced so that it is protected appropriately.**

NOTE: No devices can be taken off the crank damper as this is a tuned device for system resonance.

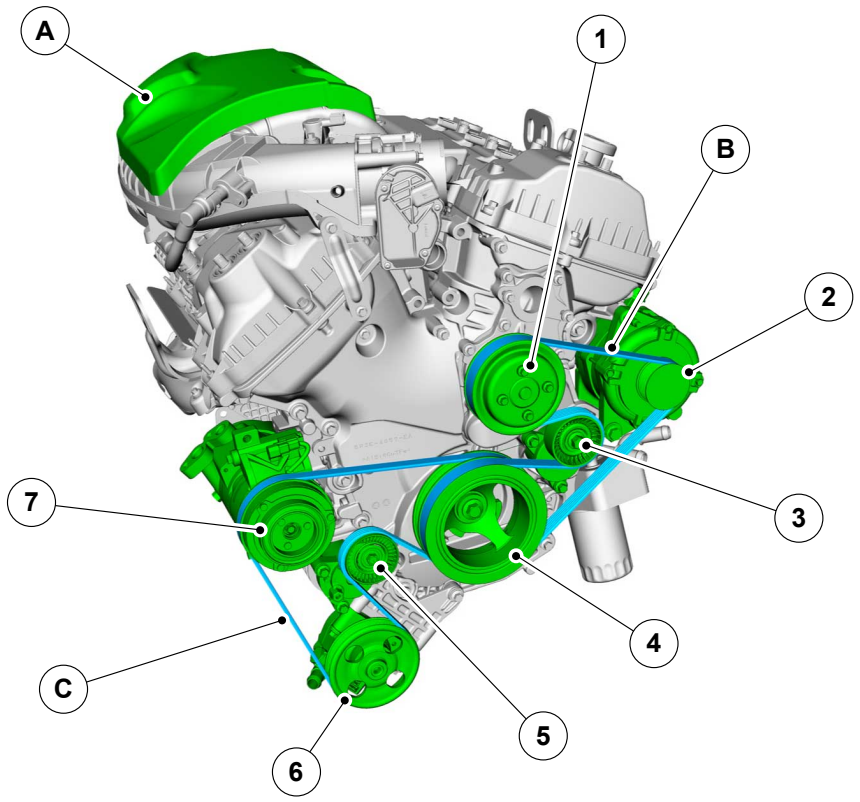
The Eigen frequency of the bracket with auxiliary unit should be above the maximum excitation frequency of the main excitation order of the individual engine at engine top speed. On V6 cylinder engines this is the third engine order. On 5 -cylinder inline engines, this is the 2.5 engine order.

RWD 3.2L Diesel Engine



Item	Description
1	Idler
2	Water Pump
3	AC Compressor
4	Fan Idler
5	Crankshaft Pulley
6	Tensioner
7	PAS Pump
8	Tensioner
9	Alternator
A	Engine Top Cover

RWD 3.5L Gasoline Engine



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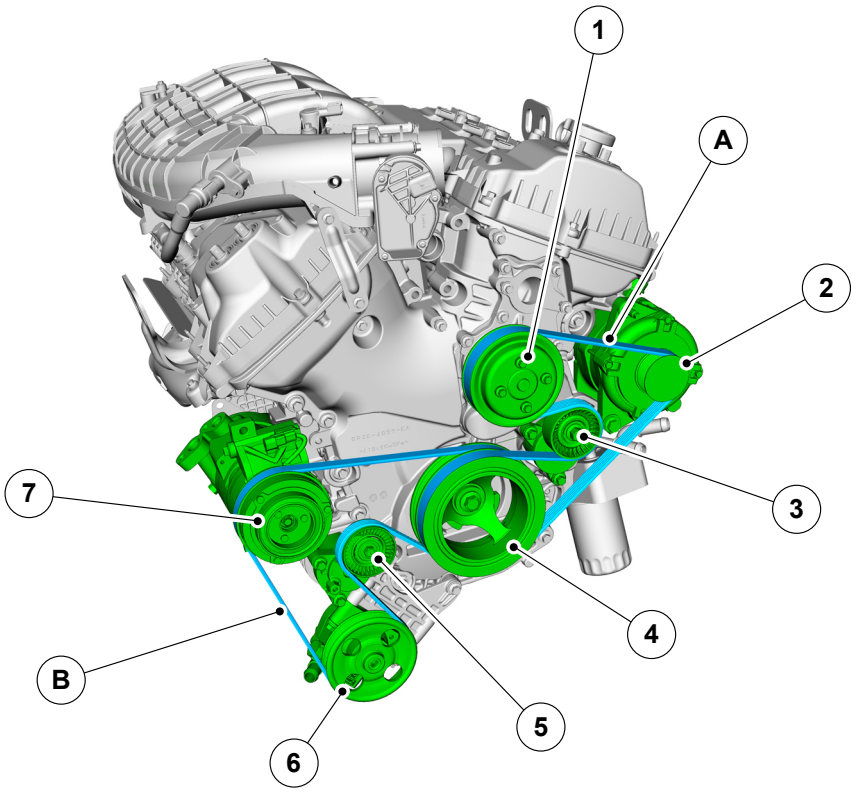
Item	Description
1	Water Pump
2	Alternator
3	Belt Tensioner
4	Crankshaft Pulley
5	Belt Tensioner
6	Power Steering Pump
7	Compressor
A	Engine Top Cover
B	Primary FEAD Belt
C	Secondary FEAD Belt

RWD 3.7L Gasoline Engine



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Item	Description
1	Water Pump
2	Alternator
3	Belt Tensioner
4	Crankshaft Pulley
5	Belt Tensioner
6	Power Steering Pump
7	Compressor
A	Primary FEAD Belt
B	Secondary FEAD Belt

3.4 Automatic Transmission

The following automatic transmission is available for 2.0L TDCi Diesel Engine.

Front Wheel Drive (FWD) vehicle

— 6F55 Transmission

WARNINGS:

Do not reroute external transmission gear shift cables.

Tachographs cannot be fitted into 6F55 transmissions.

Do not change external electrical connectors.

6F55 - 6 Speed Automatic FWD Transmission

Gears	Base Transmission Ratio	Overall Ratio - Final Drive 3.65
1st	4.484	16.367
2nd	2.872	10.483
3rd	1.842	6.723
4th	1.414	5.161
5th	1	3.650
6th	0.742	2.708
Reverse	2.882	10.519

3.5 Exhaust System

3.5.1 Extensions and Optional Exhausts

CAUTIONS:

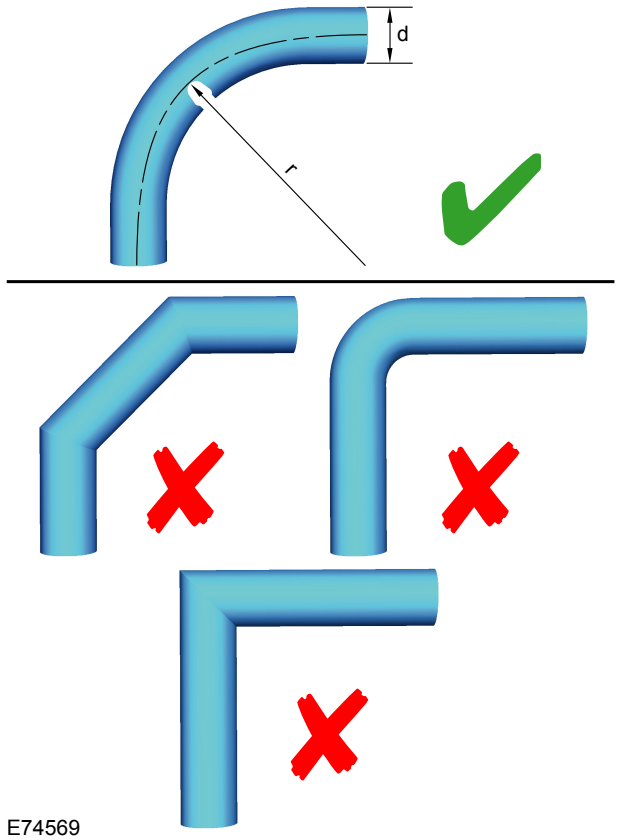
Non-standard systems must be tested for engine back pressure and all legal compliance (noise and emissions).

Make sure that for any pipes that require bending, the radius of the bend is minimum 2.5 x tube diameter.

Make sure that sufficient clearance is maintained for all driving conditions to all hot and moving components.

NOTE: Where possible all pipe connections should be designed so that the gas flows from smaller to larger diameter pipes.

Exhaust Pipe Design Principles

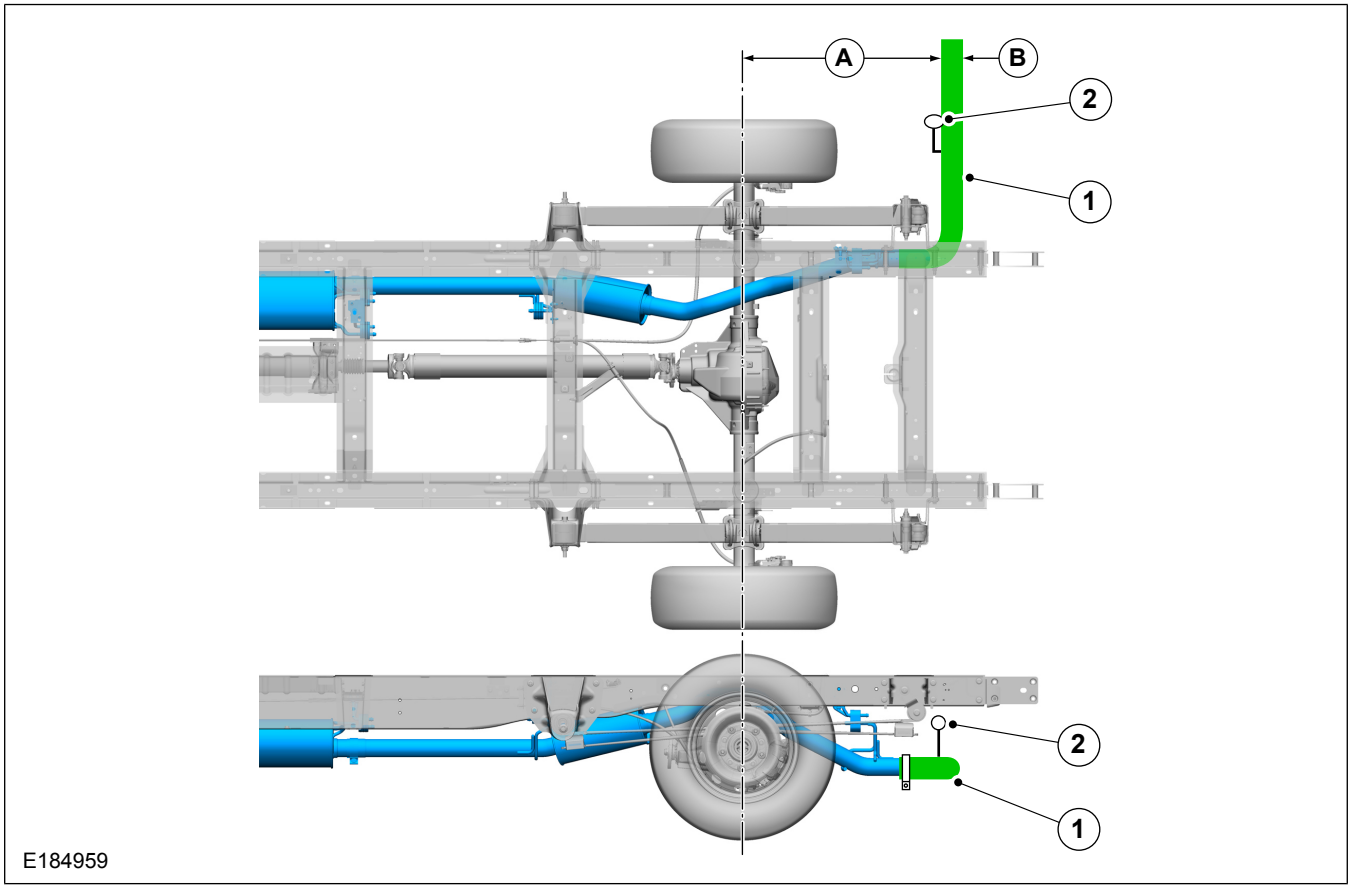


Item	Description
d	diameter
r	radius = 2.5d

When utilizing tailpipe extensions overloading the tailpipe hanger system must be avoided to ensure exhaust durability. If a ground out condition has been noted a the rear most tailpipe isolator an incremental hanger will be required. Align the exhaust so it meets Ford package recommendations. Use an exhaust isolator (CK41-5A262-A*) as a link between the exhaust and a body side hanger location.

Extensions to the exhaust outlet pipe should direct exhaust way from the body to minimize the possibility of fumes entering the vehicle. Extensions should also protrude beyond the vertical body surface.

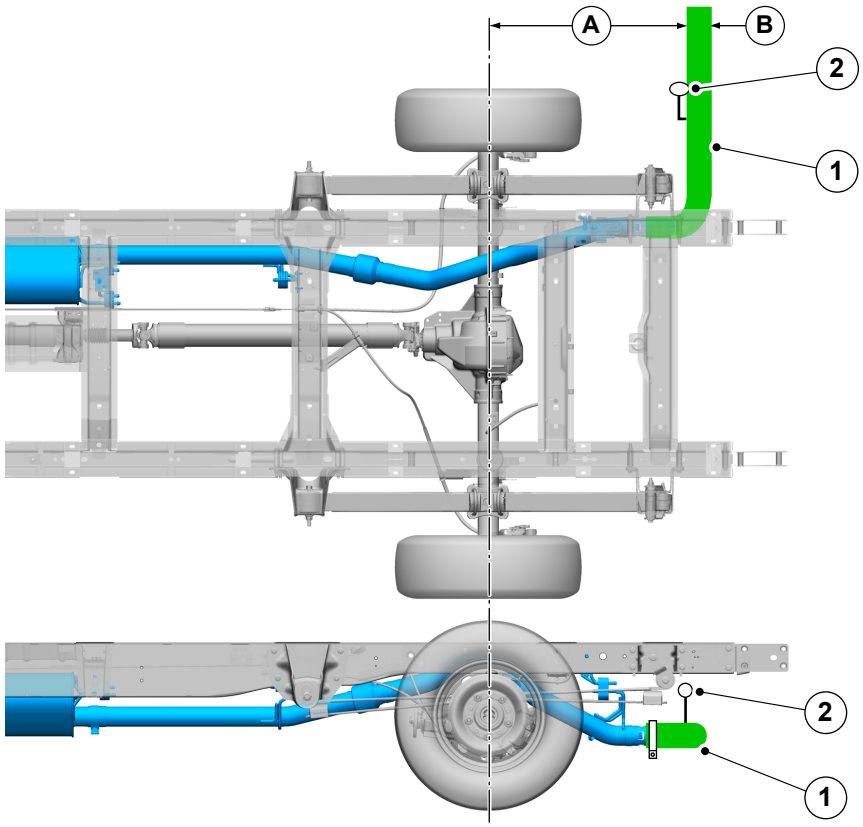
Gasoline Extended Exhaust - Chassis Cab/Cutaway



Item	Description
A	32.7" (830.6mm)
B	3" (76.2mm)
1	Extended Exhaust
2	Exhaust hanger

NOTE: This procedure is to be performed by the vehicle modifier. The service procedure is provided with the Gasoline Exhaust Modification Kit (CK41-5K238-A*) which is included on all Chassis Cab and Cutaway vehicles. For further information please go to the Body Builders Advisory Service, https://www.fleet.ford.com/truckbbas, or please contact bbasqa@ford.com

Diesel Extended Exhaust - Chassis Cab/Cutaway

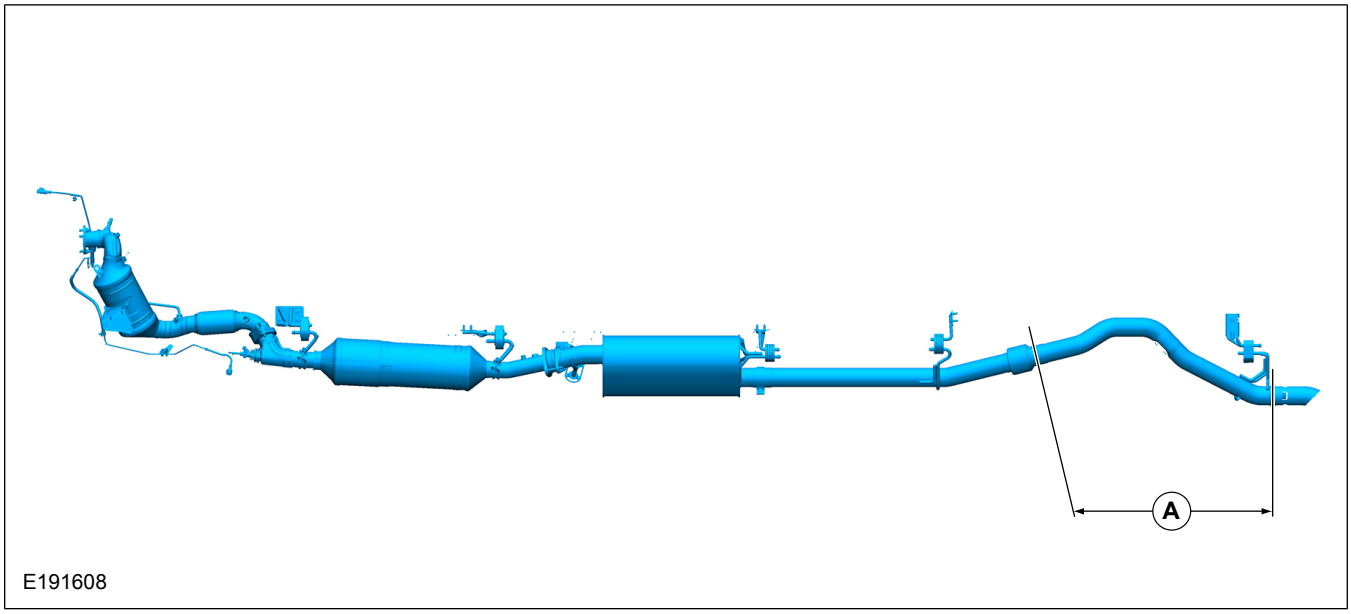


E184960

Item	Description
A	32.7" (830.6mm)
B	2.75" (69.9mm)
1	Extended Exhaust
2	Exhaust hanger

NOTE: This procedure is to be performed by the vehicle modifier. The service procedure is provided with the Diesel Exhaust Modification Kit (CK41-5K238-B*) which is included on all Chassis Cab and Cutaway vehicles. For further information please go to the Body Builders Advisory Service, https://www.fleet.ford.com/truckbbas, or please contact bbasqa@ford.com

3.2L Diesel Exhaust System



E191608

Item	Description
A	Area that can be modified - do not alter overall system restriction.

- Air entrainment position should remain in the system (primary tailpipe)
- Only the pipe section aft of the primary air entrainment can be modified
- The length from the primary air entrainment to tailpipe end can be increased in length but not decreased
- The tip cannot be removed nor altered
- Modification must not change back pressure (neither increase nor decrease)
- Appropriate heat shielding must be added if required

3.5.2 Exhaust Pipes and Supports

CAUTIONS:

Maintain the original set-up and heat shields.

Do not position any components closer than 5.9" (150mm) nominal, 3.9" (100mm) minimum clearance to the downpipe, the catalytic converter, the diesel particulate filter and any part of the exhaust system.

3.5.3 Exhaust Heat Shields

Exhaust Heat Shields

- Catalytic converters, in particular, operate at high temperatures
- Ensure existing shields are maintained
- Add further shields over exhaust system as necessary to avoid fire risk

3.5.4 Diesel Particulate Filter (DPF)

The DPF forms part of the emissions reduction systems fitted to your vehicle. It filters harmful diesel particulates (soot) from the exhaust gas. For further information

Refer to: 4.8 Electronic Engine Controls (page 98). DPF & RPM Speed Control.

Regeneration

WARNING: Do not park or idle your vehicle over dry leaves, dry grass or other combustible material. The DPF regeneration process creates very high exhaust gas temperatures. The exhaust will radiate a considerable amount of heat during and after DPF regeneration and after you have switched the engine off. This is a potential fire hazard.

Unlike a normal filter which requires periodic replacement, the DPF has been designed to regenerate, or clean itself to maintain operating efficiency. The regeneration process takes place automatically. However, some driving conditions mean that you may need to support the regeneration process.

If you drive only short distances or your journeys contain frequent stopping and starting, occasional trips with the following conditions could assist the regeneration process:

- Drive your vehicle, preferably on a main road or motor way, for up to 20 minutes avoiding prolonged idling, but always observing speed limits and road conditions
- Do not switch off the ignition
- Use a lower gear than normal to maintain a higher engine speed during this journey, where appropriate

3.5.5 Cutaway Exhaust Systems

To avoid exhaust gas ingress into the vehicle the gap in the floor between the B-pillar will require a spacer plate (not supplied). For additional information

Refer to: 5.1 Body (page 155).
Cutaway - Floor Spacer.

NOTE: For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com

3.6.1 3.5L and 3.7L Gasoline Fuel System

WARNINGS:

Do not cut into the original fuel supply lines.

Make sure that the modified vehicle complies with all relevant legal requirements.

NOTE: A 90º connector can be ordered as a service item, part number CK41-9B210-A*. The auxiliary fuel line is not offered as a serviceable item.

For vehicles without auxiliary fuel line that require a fuel supply for applications (for example: auxiliary heater) it is advisable to use the auxiliary fuel supply port on the top of the fuel sender unit located on the top of the fuel tank as shown in figure E185264

NOTE: To fit the auxiliary fuel line, the fuel tank will need to be lowered, see following process:

To lower fuel tank:

- Drain tank
- Remove filler pipe from tank
- Remove bolts securing the three tank straps
- Lower the fuel tank to gain access to the top, see Figure E185264 for fitting auxiliary fuel line

To refit fuel tank:

- Lift fuel tank ensuring not to trap fuel lines and electrical wires
- Refit straps, torque bolts to 47.5Nm ± 7.2Nm
- Refit filler pipe to tank spud securing hose clip torque to 3.7Nm ± 0.6Nm

CAUTION: Make sure that sufficient clearance is maintained for all driving conditions to all hot and moving components.

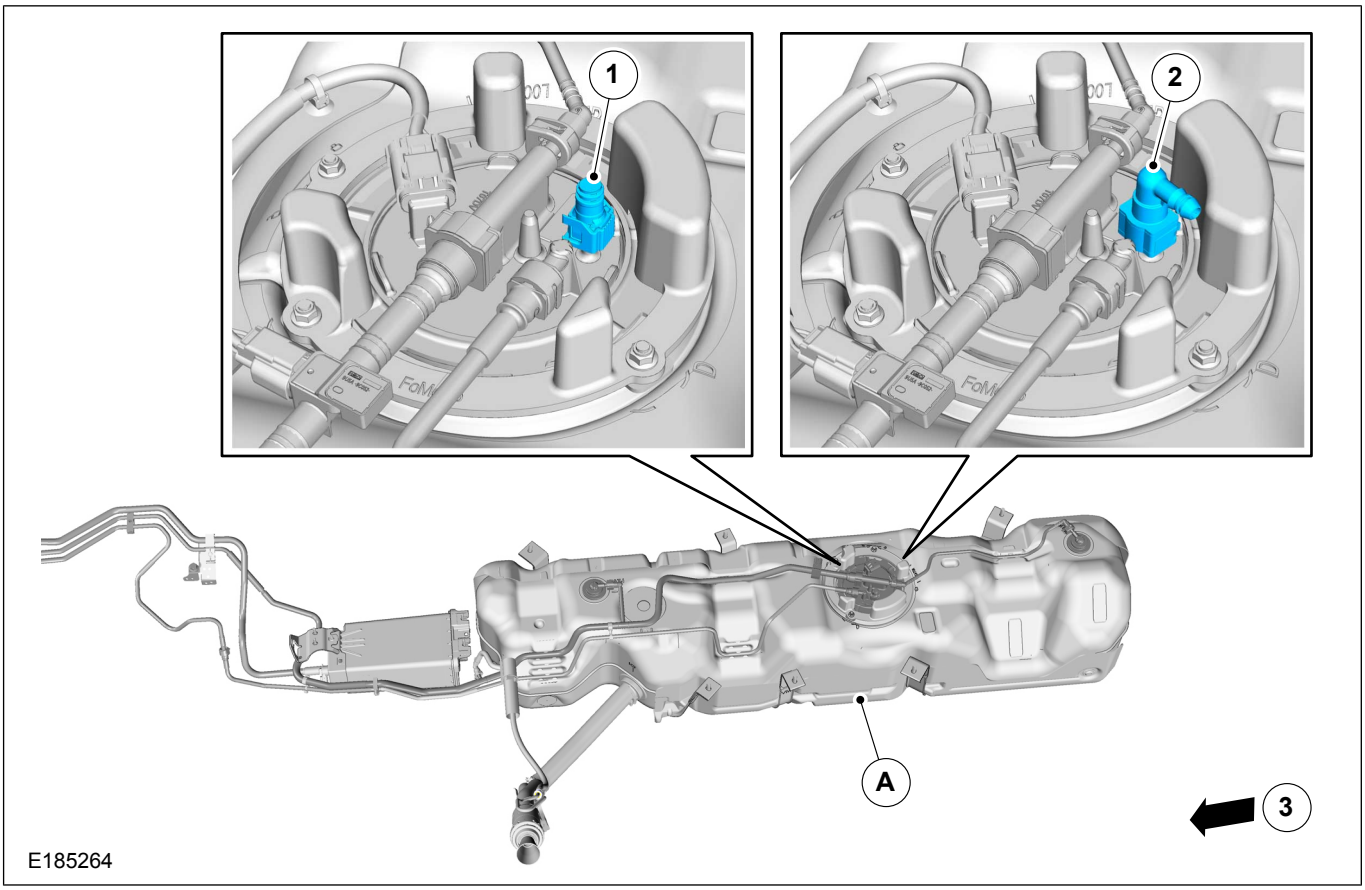
NOTE: Remove protective cap from auxiliary port on top of FDM and assemble connector.

NOTE: The tube and/or line must be routed independently and secured to the body structure or to suitable brackets.

NOTE: Ensure that a suitable fuel shut-off is fitted in any unique system.

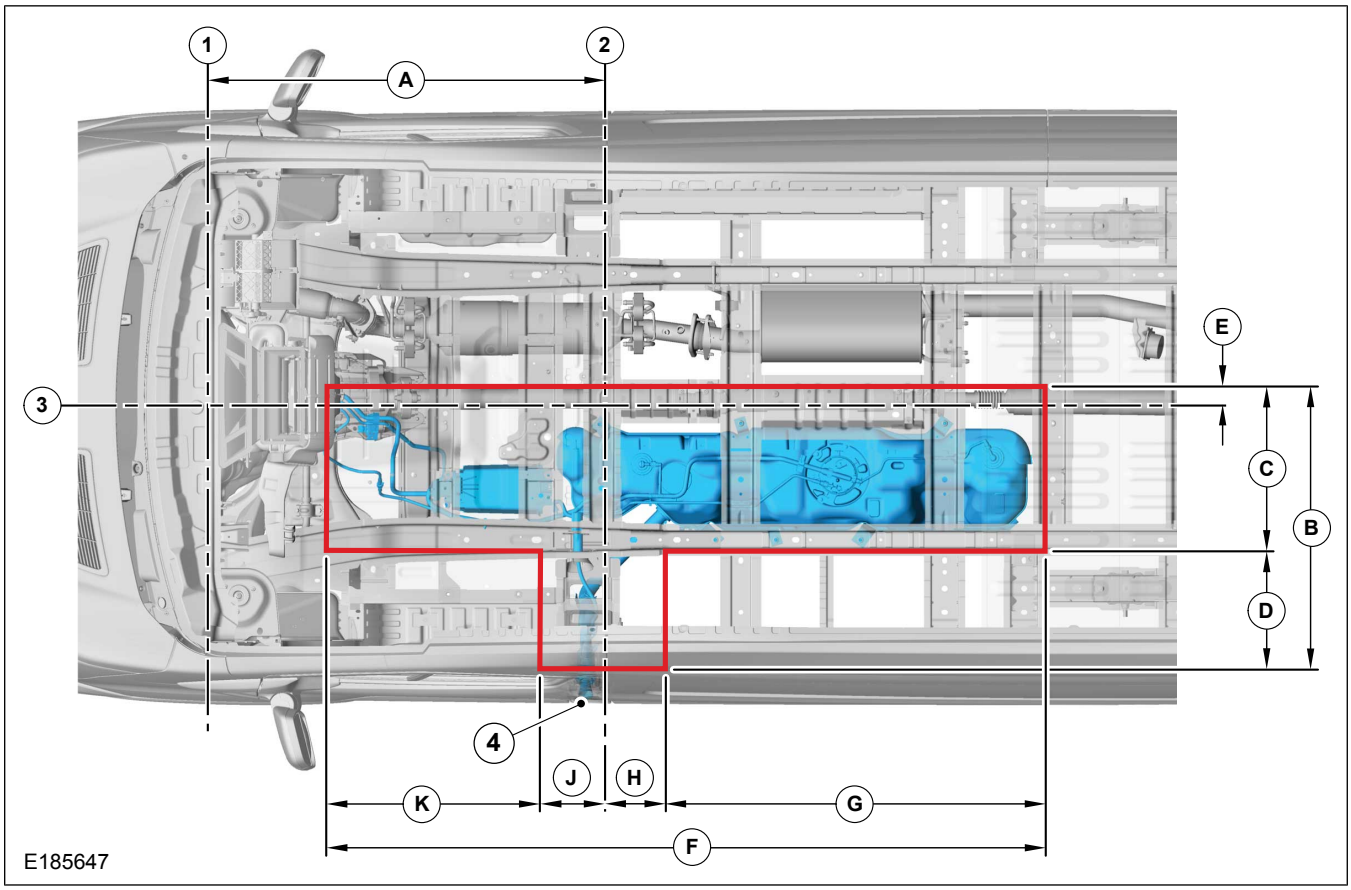
NOTE: Do not fasten anything to existing electrical components, wires or fuel lines.

Gasoline Auxiliary Fuel Port



Item	Description
A	Gasoline Fuel Tank
1	Protective cap - To remove: slide the plastic tab, squeeze the cap and pull off to expose the gasoline fuel port. Assemble quick fit 90° connector.
2	A 90° connector is required. Gasoline Aux Port kit part number CK41-9B210-A*
3	Drive direction

Floor Precautionary Drill Zones - Gasoline Fuel Tank



Floor Precautionary Drill Zones - Gasoline Fuel Tank			
1	Center Line Front Wheel Axle	D	19.3"(490mm)
2	Center Line 'B' Pillar	E	4.7"(120mm)
3	Center Line of Vehicle	F	96.2"(2445mm)
4	Fuel Fill - Driver's side 'B' pillar	G	57"(1450mm)
A	50"(1271.5mm)	H	7.9"(200mm)
B	44"(1120mm)	J	7.9"(200mm)
C	24.8"(630mm)	K	-

3.6.2 3.2L Diesel Fuel System

WARNINGS:

Do not remove or relocate fuel cooler when modifying vehicle.

Do not cut into the original fuel supply lines.

Make sure that the modified vehicle complies with all relevant legal requirements.

NOTE: A 90º connector and auxiliary fuel pick up straw are contained in the Diesel Auxiliary Port Kit, part number CK41-9B210-C*, and can be ordered as a service item. The auxiliary fuel line is not offered as a serviceable item on the diesel application.

For vehicles without auxiliary fuel line that require a fuel supply for applications (for example: auxiliary heater) it is advisable to use the auxiliary fuel supply port on the top of the fuel sender unit located on the top of the fuel tank as shown in figure E185265.

NOTE: To fit the auxiliary fuel line, the fuel tank will need to be lowered, see following process:

To lower fuel tank:

- Drain tank
- Remove filler pipe from tank
- Remove bolts securing the three tank straps
- Lower the fuel tank to gain access to the top, see Figure E185265 for fitting auxiliary fuel line

To refit fuel tank:

- Lift fuel tank ensuring not to trap fuel lines and electrical wires
- Refit straps, torque bolts to 47.5Nm ± 7.2Nm
- Refit filler pipe to tank spud securing hose clip torque to 3.7Nm ± 0.6Nm

CAUTIONS:

Ensure modifications to vehicle do not obstruct airflow to fuel cooler.

Make sure that sufficient clearance is maintained for all driving conditions to all hot and moving components.

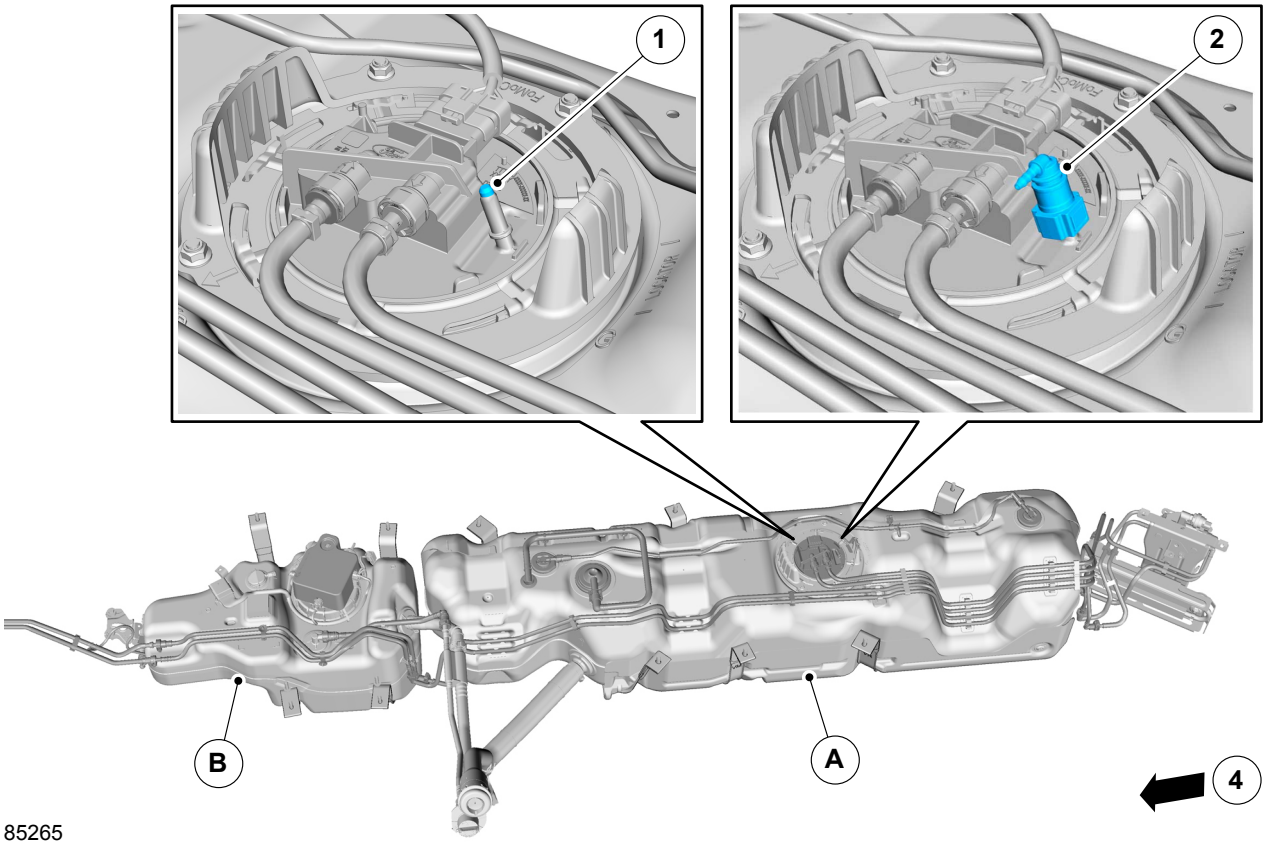
Make sure that when the port is cut that it is smooth with no sharp edges or burrs.

NOTE: The tube and/or line must be routed independently and secured to the body structure or to suitable brackets.

NOTE: Ensure that a suitable fuel shut-off is fitted in any unique system.

NOTE: Do not fasten anything to existing electrical components, wires or fuel lines.

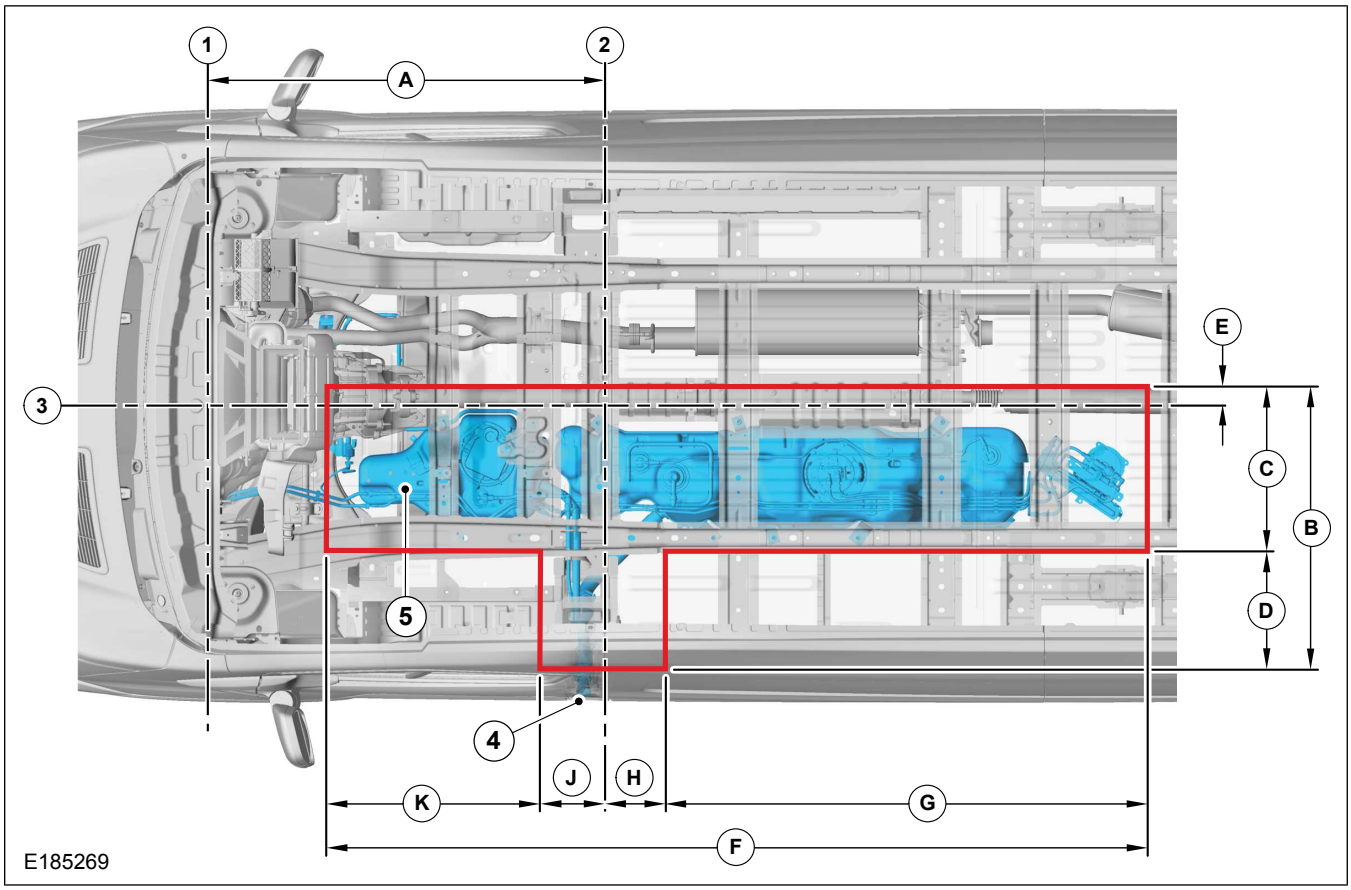
NOTE: To ensure the correct functionality of the fuel cooler, sufficient clearances are required around the fuel cooler for air flow, see figure E185269 and table for recommended clearances.



E185265

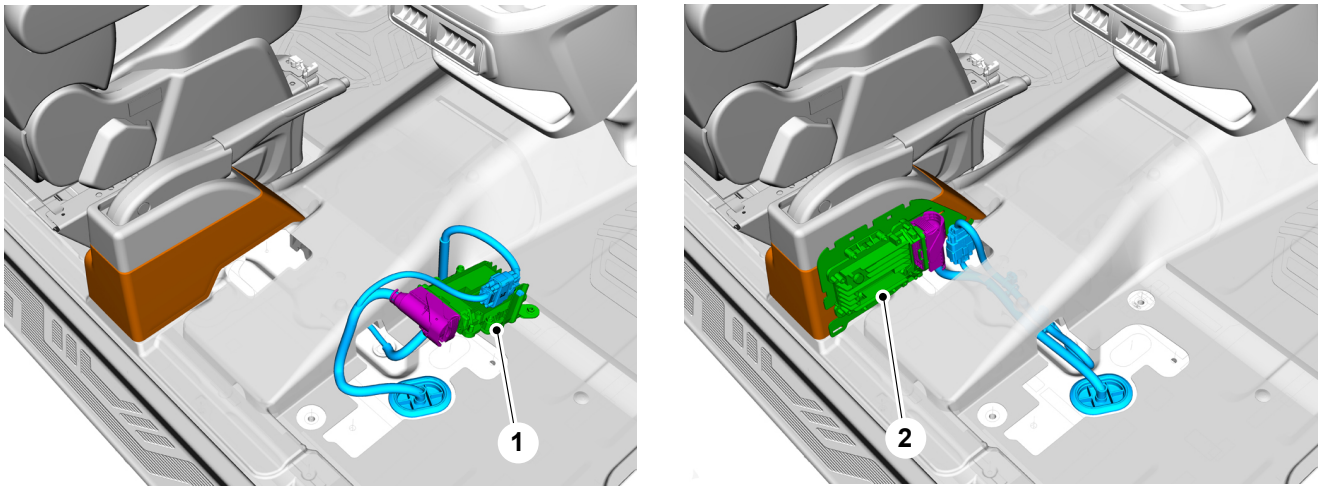
Item	Description
A	Diesel Fuel Tank
B	UREA Tank
1	Cut off top of port of diesel delivery module flange leaving 0.8 ± 0.01"(19.64 +/- 0.12mm) and carefully insert auxiliary fuel pick up straw. Attach 90º connector to the top of the auxiliary port. Diesel Aux Port Kit part number CK41-9B210-C* is required.
2	Recommended mating part: Auxiliary line PA12/ETFE or PA6/12/ETFE. 0.3"(8mm) outside diameter, 0.2"(6mm) inside diameter.

Floor Precautionary Drill Zones - Diesel Fuel and UREA Tanks



Floor Precautionary Drill Zones - Diesel Fuel and UREA Tanks			
1	Center Line Front Wheel Axle	D	19.3"(490mm)
2	Center Line 'B' pillar	E	4.7"(120mm)
3	Center Line of Vehicle	F	105.3"(2675mm)
4	Fuel/DEF Fill - Driver's side 'B' pillar	G	66.1"(1680mm)
5	UREA Tank	H	7.9"(200mm)
A	50"(1271.5mm)	J	7.9"(200mm)
B	44"(1120mm)	K	31.3"(795mm)
C	24.8(630mm)	-	-

Dosing Control Unit (DCU)



E191607

Item	Description
1	DCU position under passenger seat
2	DCU relocated position next to park brake

NOTE: Vehicles with Diesel Engines and less passenger seat will need to relocate the DCU using Kit CK41-5L258-AA, fitting instructions are included in the kit. See figure E191607 for DCU location.

4.1.1 Wiring Harness Information

NOTE: Ford Motor Company has no control over the modification or installation process of the electrical content of auxiliary systems and therefore can take no responsibility for such installations.

The following provides an installation guide for any electrical modifications or additional systems being added to the vehicle. The aim is to maintain robust integration of auxiliary systems without compromising existing systems, in areas such as splicing techniques into existing wiring, module package location and EMC issues. It is also expected that the vehicle modifier will test their installation and comply to all legal and homologation requirements.

4.1.2 General Wiring and Routing

Temperature requirements: Wiring systems in the vehicle interior are expected to function over the temperature ranges of –40ºF to 185ºF (–40ºC to 85ºC) for exposure and –40ºF to 167ºF (–40ºC to 75ºC) for function. For engine compartment and underbody, the minimum temperature is -40ºF (-40ºC), while the maximum exposure and operational temperatures are 257ºF (125ºC) for exposure and 221ºF (105ºC) for operational.

Make sure that the insulation is compatible with any fluids it may encounter, for example: gasoline, oil, antifreeze, brake fluid, transmission fluid and power steering fluid.

If a connector will be located in a hostile environment or wet area use a sealed connector. 'Hostile environment' areas include the engine compartment, wheel wells, underbody and doors.

Do not route wires near weld points or weld flashes. A minimum of 0.6" (15mm) clearance to any sheet metal welds under static and dynamic conditions is required. However, it is best to avoid routing near weld points or weld flashes at all times.

In general, the distance between retention points for wiring not contained in a rigid shield should be less than 11.8" (300mm).

A minimum 1" (25mm) clearance is recommended from all sharp edges and a minimum 1.4" (35mm) clearance of all moving parts of the parking brake assembly. If these clearances can not be met, protect the wires with a convolute.

For vehicle modifications with walkthroughs, it is recommended to provide appropriate protection on the floor in the walkway.

4.1.3 Connector Pin Out Practices

When designing a harness to component connection, it is best practice to put the female terminals in the harness side connection and the male terminals in the component side. When determining connector pin outs, make sure that power and ground circuits are not in close proximity, adjacent, to one another. A minimum separation of 0.2" (5mm) between power and ground circuits is required.

WARNING: Do not use connectors which cut through the outer covering and into the core wire.

CAUTION: It is recommended to only use Ford approved connectors.

Cutting into vehicle wiring is not permitted because:

- The base vehicle specification is unsuitable for incremental loads except in conjunction with the Auxiliary Fuse Panel
- Long term risk of a faulty connection developing
- Potential fire risk from over-loading

All connections into existing wiring must be permanently insulated. Exterior connections must be water-proof.

When designing electrical circuits, or making alterations, the following must be considered:

- Current rating of wiring, see table 'Current Rating of Wire Sizes' in this section
- Any voltage drop in the circuit should not lower the terminal voltage at consumption point to below 95% of battery voltage
- Do not cut into the original harness
- Additional grounds should be included to support new equipment
- A supplementary circuit diagram and accompanying instructions should be added to the Owner's information or a separate manual supplied with the vehicle for each unique component

NOTE: For further information please contact bbas@ford.com

4.1.4 Unused Connectors

The harnesses may have a number of unused connectors, which are dedicated to other features and options, for example heated seats, but are **not** always present depending on level of harness fitted. Ford **does not** recommend the use of these connectors for any other purpose than that intended by design.

4.1.5 Grounding

Drill point screws are not to be used for any ground attachments:

- Do not ground to moving structures, for example: doors, deck lids, lift gates, as the ground return path through the hinges is not reliable
- Do not place more than 2 eyelet terminals under a single ground screw
- Do not place electrical component attachments or ground screws adjacent to vehicle fuel tanks or fuel lines

4.1.6 Prevention of Squeaks and Rattles

Wiring should be positively retained every 5.91 to 9.84" (150 to 250mm). All connectors should be positively retained. Use tapes which do not squeak against metal or plastic.

4.1.7 Water Leakage Prevention

Make sure that drip loops are provided to prevent water leakage into the vehicle interior, passenger and cargo compartments, using wiring assemblies that pass from outside into the vehicle interior. The drip loop is a section of wiring that is deliberately formed and routed BELOW the point of entry into the vehicle, so that gravity assists in forming water droplets that escape from the lowest part of the wiring.

Wiring from door to passenger compartment, should be made such that the door entry point is below the passenger compartment entry point, which creates a type of drip loop.

4.1.8 Wiring Splicing Procedures

TYCO-RAYCHEM crimp splices

E131081

Ford Motor Company strongly advises against the use of wire splicing due to the variable and unpredictable nature of making robust, durable and reliable connections. However, if it is deemed that a wire splice is absolutely unavoidable, it must be made with **DuraSeal Heat-Shrinkable, Environmentally Sealed, Nylon-Insulated Crimp Splices** (manufactured by TYCO-RAYCHEM). For example the D406 series. As a further process to improve the splice integrity, the splice should be further sealed with a suitable heat shrink tubing. See Figure E131081.

4.1.9 Wiring Specification

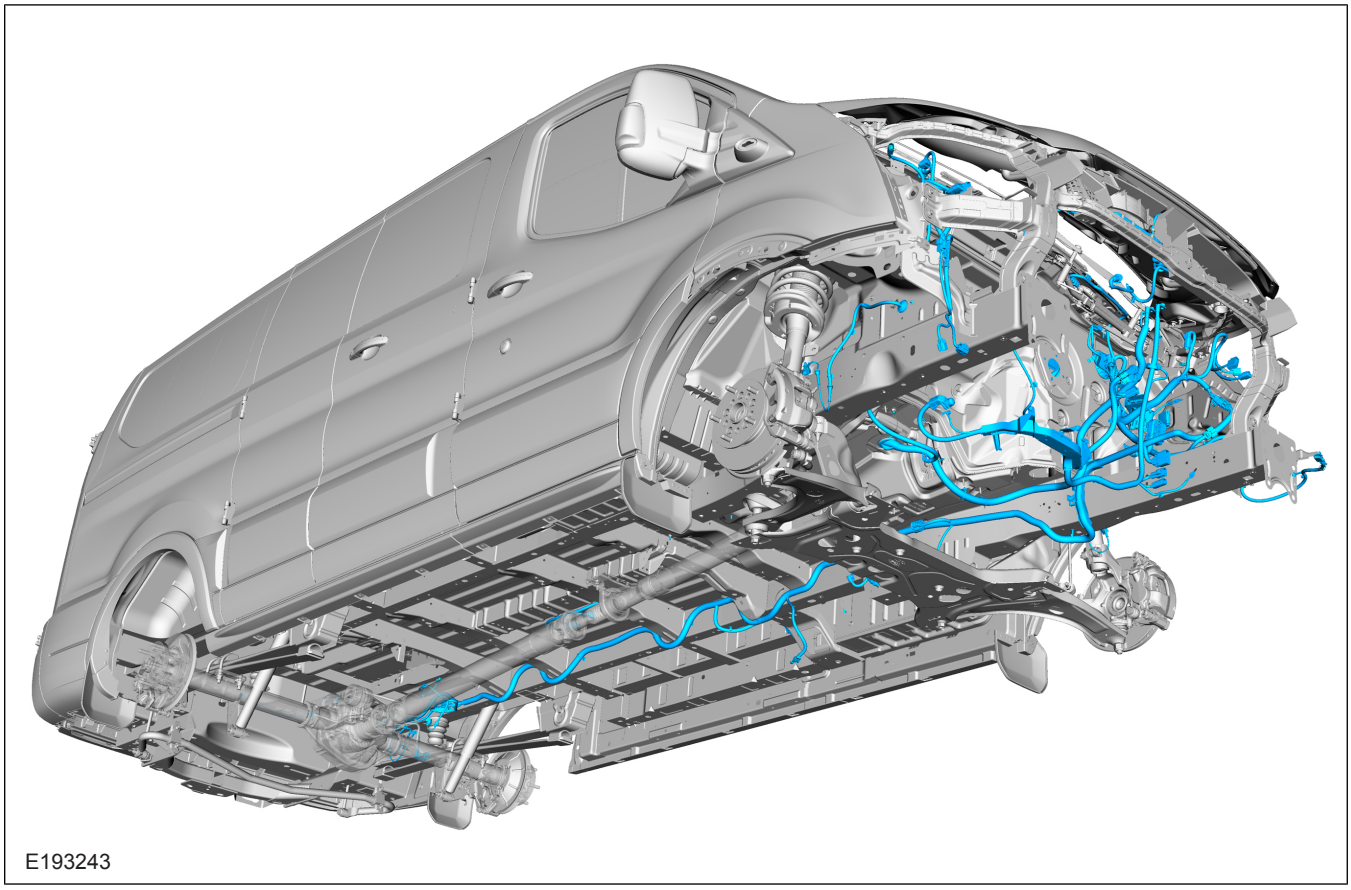
Current Rating of Wire Sizes

		Maximum Continuous current (A)	
Cross Sectional Area	**mOhms/m@68°F**	**86°F**	**122°F**
0.35	54.4	7	4.9
0.5	37.1	11	7.7
0.75	24.7	14	9.8
1	18.5	19	13.5
1.5	12.7	24	17.0
2.5	7.6	32	22.7
4	4.71	42	29.8
6	3.14	54	38.3
10	1.82	73	51.8
16	1.16	98	69.6
25	0.743	129	91.6
35	0.527	158	112

NOTE: The maximum continuous current (A) values for 86ºF to 122ºF (30ºC and 50ºC) is a value below the maximum fuse rating allowed for the cable. This is because the fuse/cable system values at these temperatures are the continuous usage where as the maximum fuse also needs to protect for high current short term loadings such as electric motors.

When designing wire installations for additional equipment use the cable size recommended by the equipment manufacturer or select a suitable size from the 'Current Rating of Wire Sizes' table.

4.1.10 Electromagnetic Compatibility (EMC) Awareness



E193243

Electromagnetic Compatibility (EMC) Awareness

The installation and routing of Ford wiring, (example of wiring shown in figure E167556), have been fully-validated and have passed the requisite EMC tests. Ford Motor Company, however, are not responsible for the vehicle's EMC immunity when non-Ford-approved systems are installed.

WARNING: Do not route other wiring near/close to electrical cables with the Anti-Lock Brake System and Traction Control System cables because of extraneous signal risk. It is generally not recommended to hang extra wiring off existing looms or tubes.

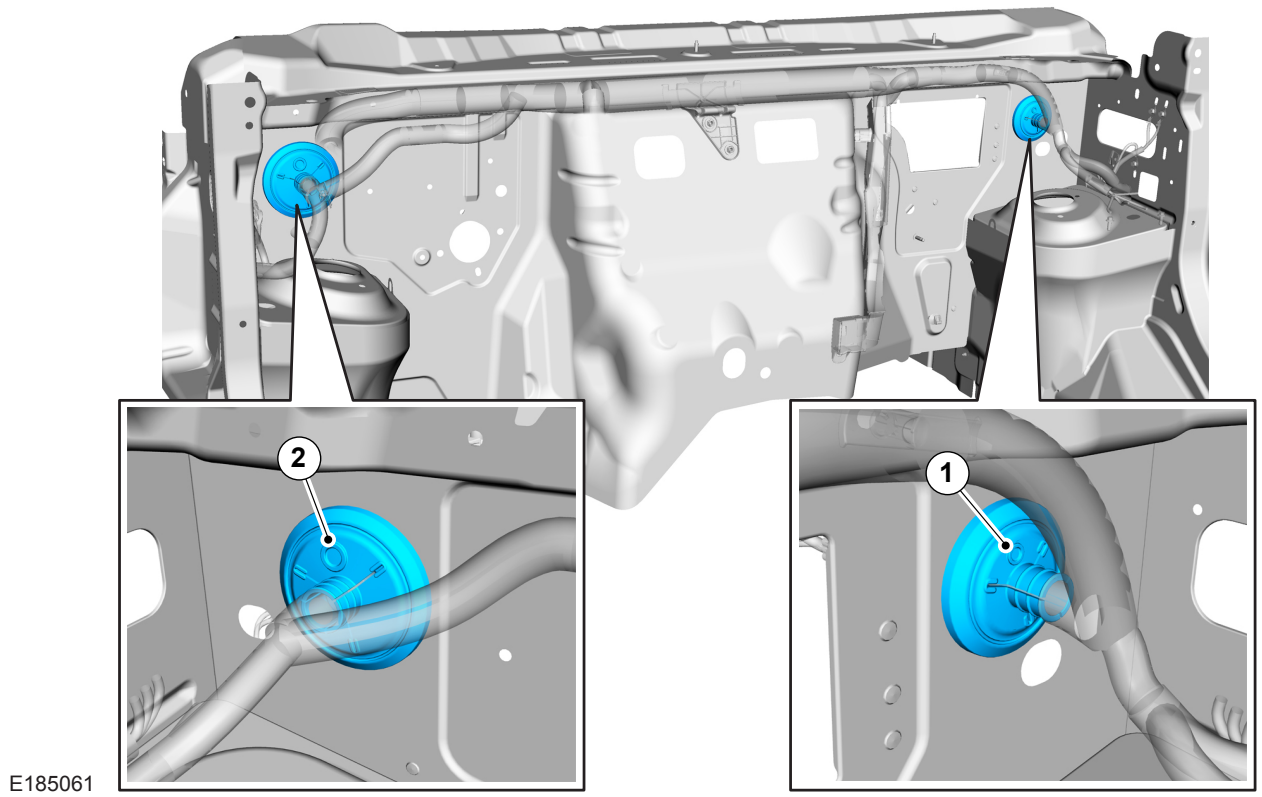
Wiring must be suitably fixed without any detrimental effect on other wiring.

Single or bunched looms must maintain the following clearances:

- 0.4" (10mm) from static components (unless clamped to it)
- 9.8" (250mm) from exhaust system
- 1.2" (30mm) from rotating or moving components

4.1.11 Wiring Through Sheet Metal

Front Wheel Drive Dash Panel (Left Hand Drive Shown)



Item	Description
1	Dash Grommet Left Hand Side
2	Dash Grommet Right Hand Side

WARNING: Harnesses passing through sheet metal must be through protective grommets that also ensure a watertight seal. A windshield type sealer should be used. Adhesive or tape is not acceptable.

NOTE: Holes must permit the appropriate connector to pass through.

NOTE: Two pass through circuits are provided as part of the modified vehicle wiring package.

Refer to: 4.18 Electrical Connectors and Connections (page 128).

There are two locations in the dash panel which have been identified to route wires through. See figure E185061 (view from engine bay) for locations. The number of suitable locations will depend on the vehicle specification.

Ford released hardware is available to support further installations to the vehicle. Only this hardware and released parts are to be used for this.

4.1.12 Precautionary Drill Zones — Rear Cargo Area

Precautionary Drill Zones — Rear Cargo Doors /Low Roof

CAUTION: Do not drill into the vehicle before checking 'Precautionary Drill Zones' and electrical harness routing.

The areas marked in blue on figures E188483 - E188488 show the 'Precautionary Drill Zones' for the rear cargo area where there is wire routing. Caution should be taken when drilling in these areas to not damage wiring harnesses, (for example: when installing cladding and racking). The same care should also be taken when using self tapping screws. Not all derivatives are shown but the routing is the same for roof line and wheel base with regards to 'B', 'C' and 'D' pillars or roof bows and doors. Other non electrical systems may also be present, for example: fuel tank under floor so it is important to check before drilling. For additional information refer to the following links.

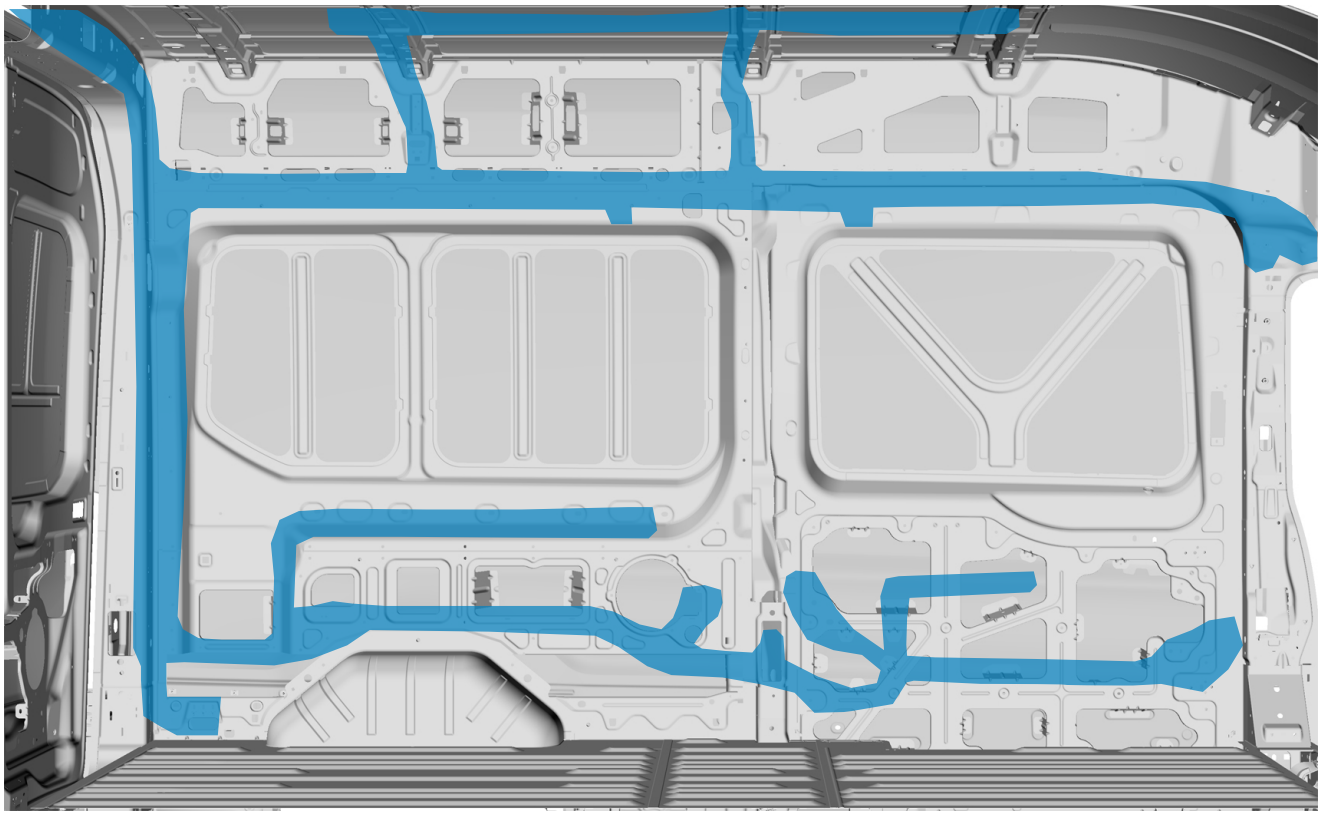
Refer to: 5.1 Body (page 155).

Precautionary Drill Zones -Under the Floor Tank
Refer to: 5.4 Loadspace (page 176).
Load Compartment Tie Downs
Refer to: 5.3 Racking Systems (page 173).
Refer to: 5.5 Body Closures (page 177).
Precautionary Drill Zones - Closures

For vehicle wheelbase and Roof height

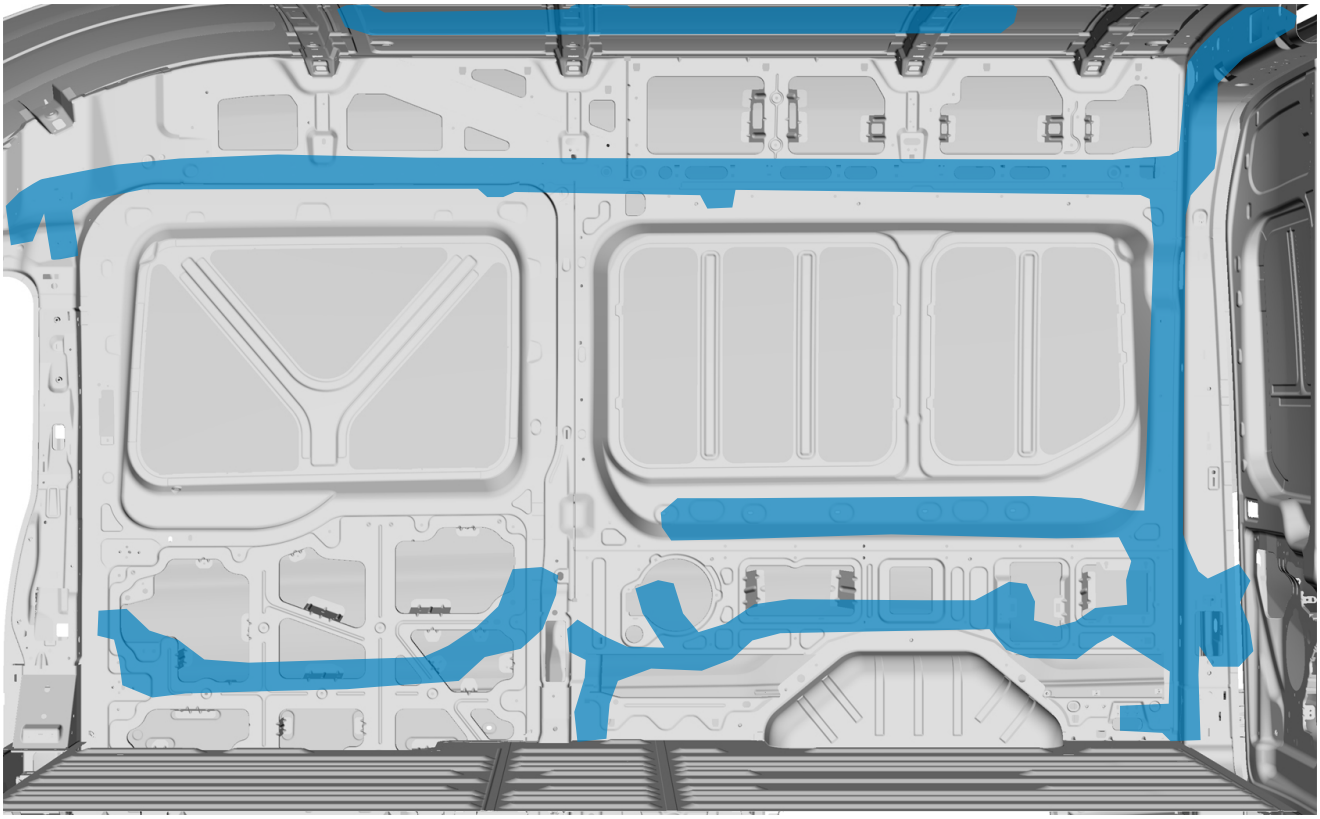
Refer to: 1.10 Package and Ergonomics (page 16).
'Vehicle Dimensions' in this manual

Precautionary Drill Zones - Long Wheelbase/High Roof/Left Hand Side



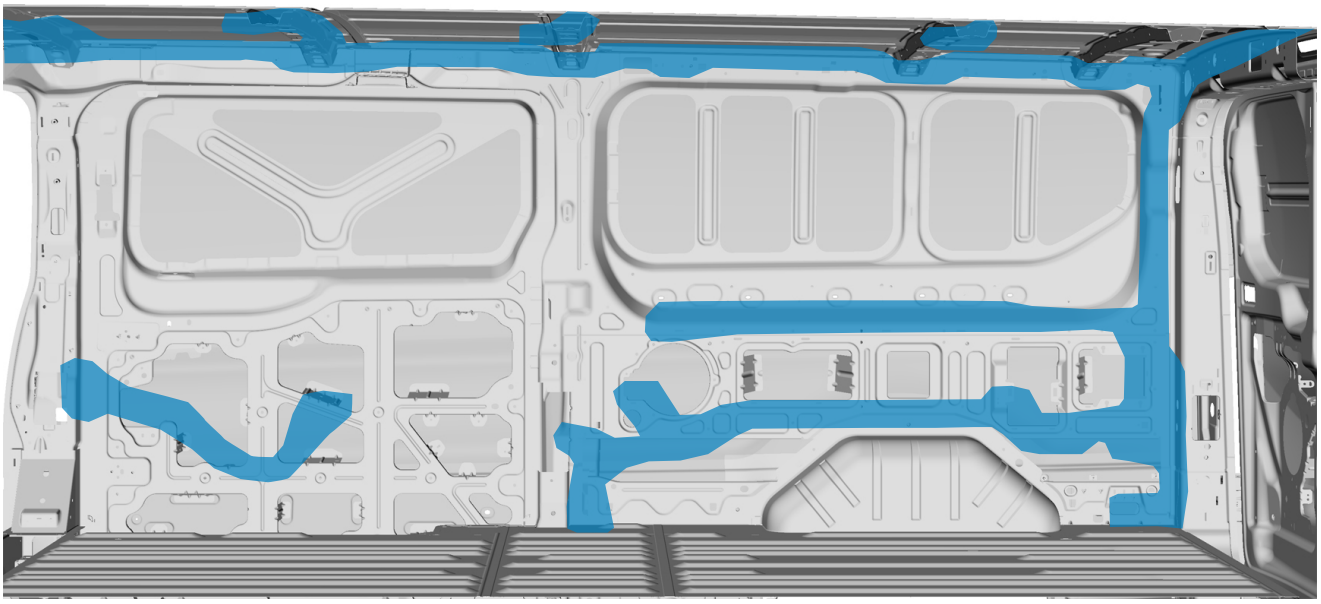
E188484

Precautionary Drill Zones - Long Wheelbase/High Roof/Right Hand Side



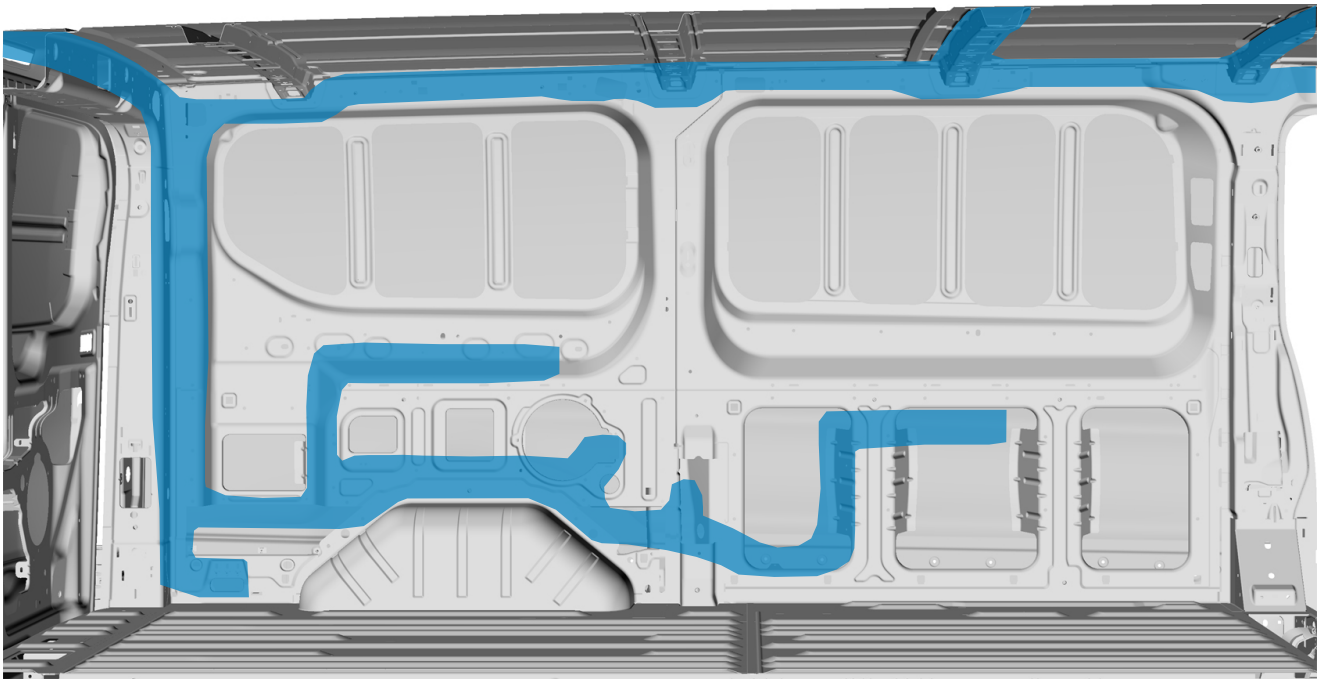
E188486

Precautionary Drill Zones - Side Load Doors/Long Wheelbase/High Roof/Right Hand Side



E188487

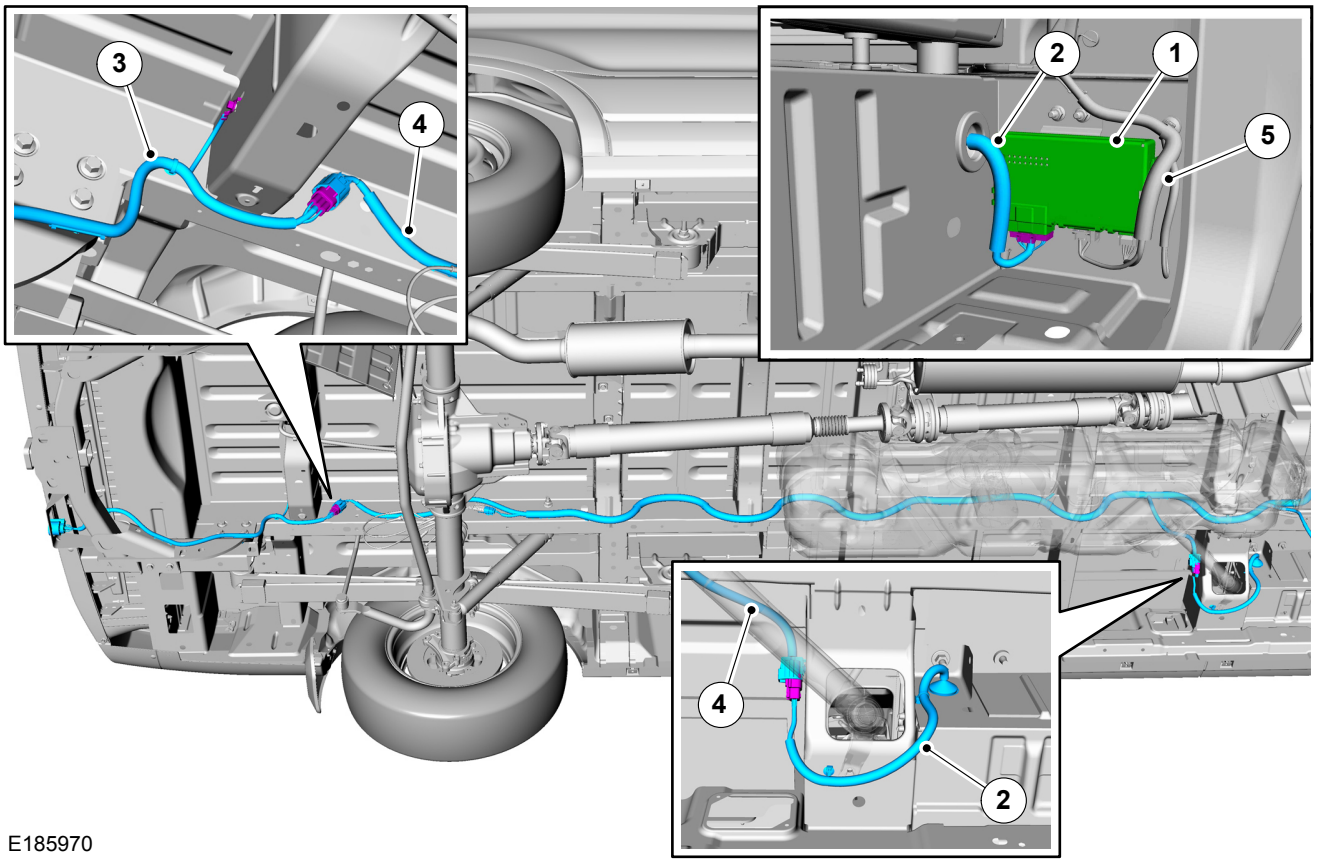
Precautionary Drill Zones - Medium Wheelbase/Low Roof/ Left Hand Side



E188485

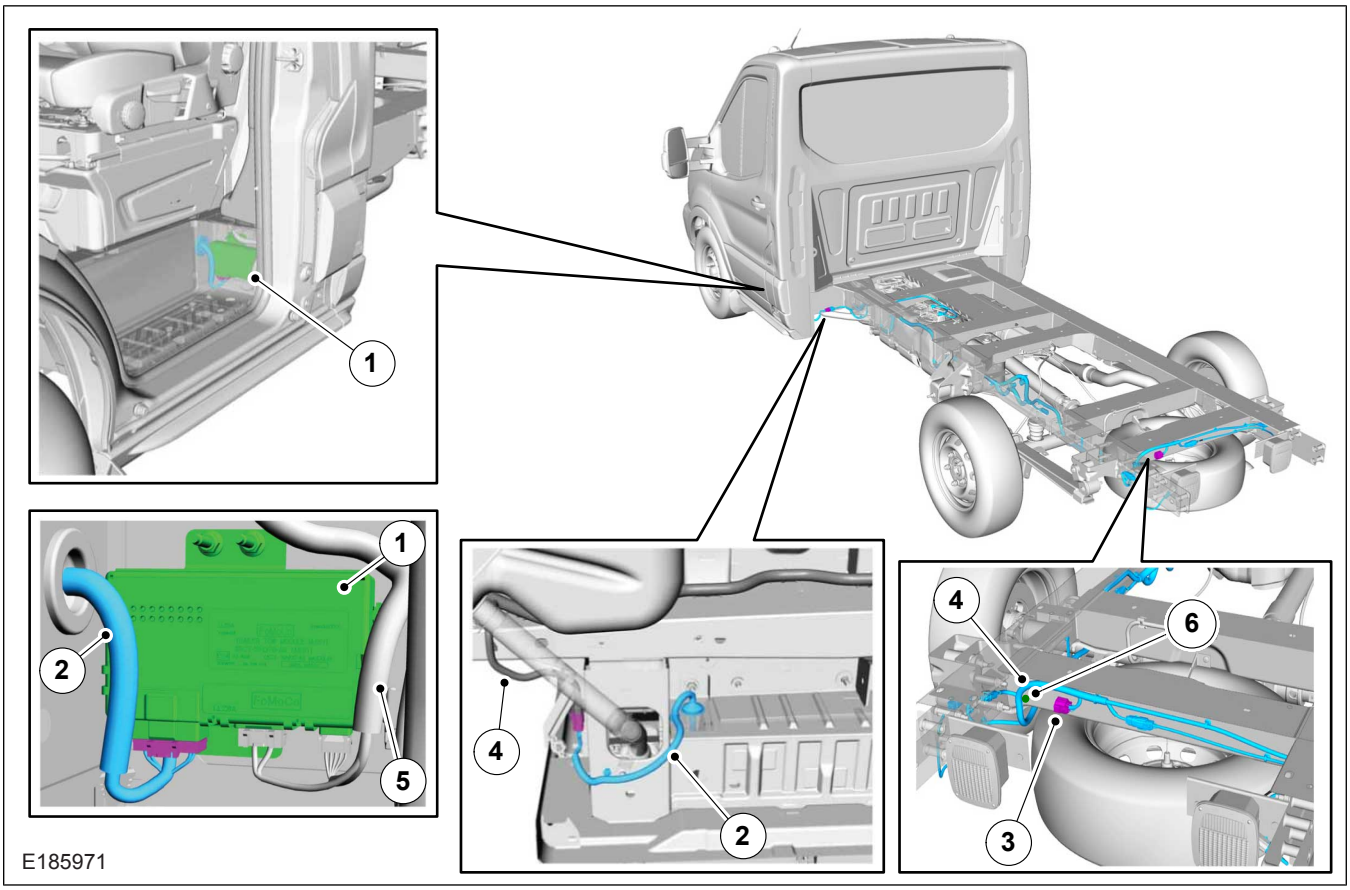
4.1.13 Electrics for Tow Bar

Trailer Tow Module and Harnesses - Van, Wagon Vehicles



Item	Description
1	Trailer Tow Module
2	Trailer Tow Module Jumper
3	Trailer Tow Socket Jumper
4	Fuel Tank Harness
5	Main Harness

Trailer Tow Module and Harnesses - Chassis Cab Vehicles



E185971

Item	Description
1	Trailer Tow Module
2	Trailer Tow Module Jumper
3	Trailer Tow Socket Jumper (Part of Trailer Tow Prep Pack)
4	Fuel Tank Harness
5	Main Harness
6	Ground Bolt fixing point (see also GP38 in 'Grounding' section of this manual)

Tow bar electrical system may be ordered as a 7-pin DIN connector, as part of the original vehicle build.

Where it is required to add trailer towing to an existing vehicle, and to ensure compliance with lighting regulations, the appropriate wiring accessory kit can be obtained from your loca Ford dealer.

Fitment of non-Ford trailer tow wiring is not advisable due to Body Control Module control of lighting, and meeting legal lighting regulations. Contact your local Ford dealer for details of a harness that connects to the base vehicle harness.

NOTE: The Ford trailer tow system is integrated with the Ford park aid system. When a trailer is connected, the system communicates on CAN only, to deactivate reverse park aid feature, there is no hardwired interface. It is not possible to turn off reverse park aid with an aftermarket trailer tow system.

NOTE: For Van tow bars it is necessary to connect into the rear lamp unit.

NOTE: If tow bar connectors are not used, appropriate fixing and cover must be applied for protection from water and contaminant ingress.

NOTE: The trailer detect circuit is part of the Ford Trailer Tow module, it can only be implemented on vehicles with power locking and perimeter.

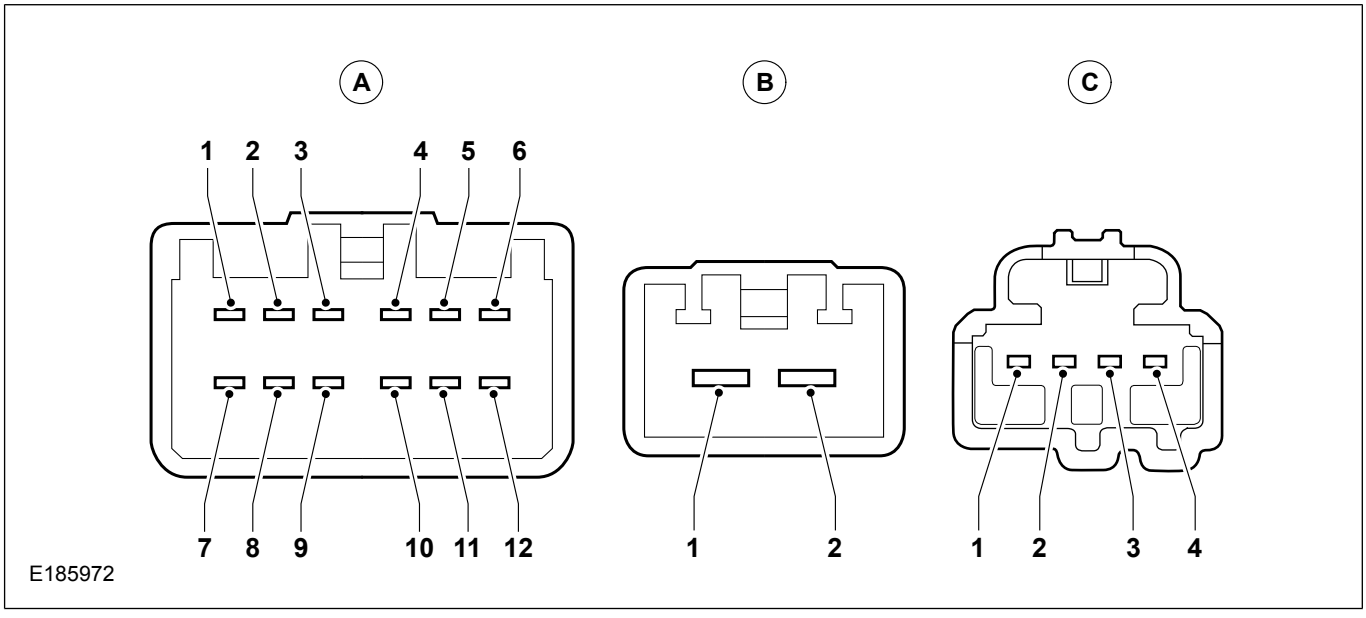
The Trailer Tow Module (TTM) can support pure LED trailer lights as long as each circuit exceeds 500mA, below this and the system will not detect a trailer has been connected and shuts down all outputs (sleep mode). It is recommended to target a 550mA minimum load to allow for system tolerances. This would need to be obtained with a supplemental load resistor, if the LED lighting circuits are below this threshold.

A higher current is interpreted as short circuit. If a short circuit is detected the related output will be switched off. The following table shows the recommended output maximums per circuit.

Trailer Tow Module Connectors (Figure E185972 and E185973)

	Feature	Current (A)		Voltage (V)	
Component Terminal Number	**Circuit Number**	**Min**	**Max**	**Min**	**Max**
Connector A					
1	Left Turn Lamp/Stop Lamp	-	15	8	16
2	Not Used	-	-	-	-
3	Battery Charge	-	27.4	8	16
4	Not used	-	-	-	-
5	Not used	-	-	-	-
6	Not used	-	-	-	-
7	Not used	-	-	-	-
8	Right Turn Lamp/Stop Lamp	-	15	8	16
9	Not used	-	-	-	-
10	Not Used	-	-	-	-
11	Not used	-	-	-	-
12	Position Light	-	-	-	-
Connector B					
1	Battery Charge Feed	-	27.4	8	16
2	Term 30 (Vbat)	-	30.7	8	16
Connector C					
1	Ground	-	0.5	8	16
2	CAN L	-	0.1	8	16
3	CAN H	-	0.1	8	16
4	Trailer Detect Output	-	-0.013	-8	-16

Trailer Tow Module Connectors



E185972

The TTM has a battery charge of 30A. The feed is protected by a 30A fuse (not in TTLM but in the vehicle fuse panel). It is NOT protected for current overload. The fuse will blow if the current is exceeded.

For following functions Delphi LED detection limit of typically 330mA (110mA - 660mA)

- Stop Light
- Turn Indicator

Summary of Current:

- Max load for Turn/Stop Lamps is 15A each
- Total module is 30A for Lamp loads

The Park/Reverse Lamp is a relay located in the vehicle not in the TRM module.

If trailer tow system is to be added, the correct wiring and module needs to be ordered. The vehicle needs to have Central Car Configuration (CCC) programmed to the correct parameters:

CCC Parameter 20

- 0x01 without trailer tow
- 0x08 Trailer Module 7 - Pos Socket

NOTE: It is mandatory that a trailer is detected. Therefore at least one of the following lights have to be connected in the **on mode** or in the **standby mode** (anti-theft mode): Stop right, Stop left, Position lights or Direction indicator left.

Trailer connect will be detected if a load is detected on the Right Turn/Stop or Left Turn /Stop Lamps. If the current loads for either lamp are exceeded, the module will shut the driver off and send a message to the instrument cluster that the lamp driver has failed. The module will also detect if either the right side or left side is open (for example the lamp is burned out).

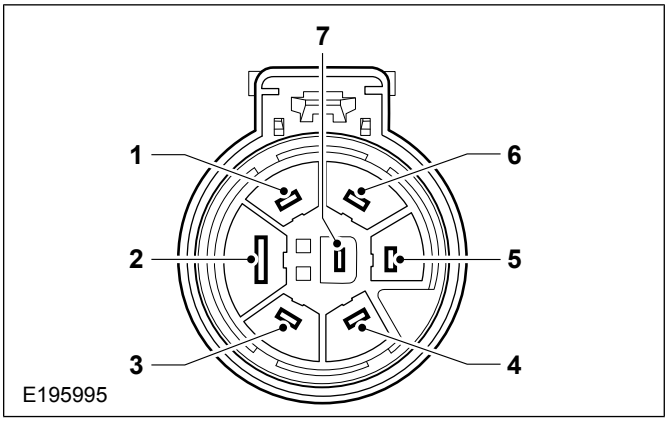
If a short circuit is detected or an overheating of the drivers occurs, the related output remains off until an ignition cycle is performed and the engine is restarted.

The trailer detection uses a strategy of having a 1K ohm resistor if the lights are not actually switched on to detect that the trailer has been connected. If a trailer light is already switched on the related current will be checked.

NOTE: Extended wheelbase vehicles with less Trailer Tow option and have Fuel Harness CK4T-14406-RZ will not have the connector for Trailer Tow Socket Jumper

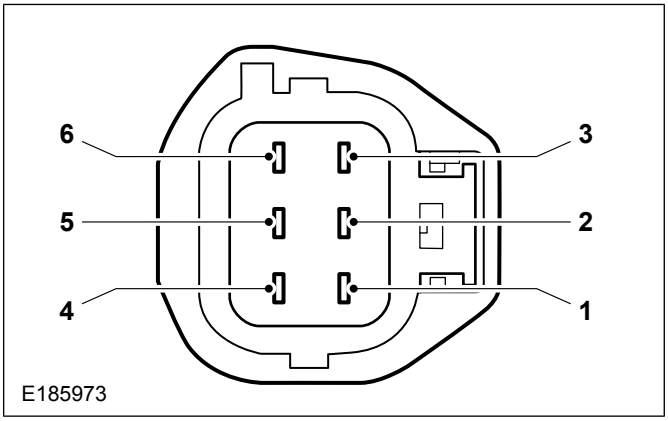
4.1.14 Trailer Tow Connectivity

Trailer Tow 7 Pin Socket



7 Pin Trailer Tow Connector	
Pin 1	Turn/Stop Lamp Left
Pin 2	Power Ground - To Chassis Point Off 13B576
Pin 3	Trailer Tow Brakes
Pin 4	Turn/Stop Lamp Right
Pin 5	Power Ignition ON
Pin 6	Park Lamps
pin 7	Trailer Tow Back-Up Lamps

Trailer Tow 14406 Interface Connector In-line to 13B576



In-line to 13B576 (on harness 14406)	
Pin 1	Turn/Stop Lamp Left
Pin 2	Turn/Stop Lamp Right
Pin 3	Park Lamps
Pin 4	Trailer Tow Back-Up Lamps
Pin 5	Power Ignition ON
Pin 6	Trailer Tow Brakes

Trailer Position and Back-Up Lamps are by relay (not BCM). Position lamps R3 and Back-Up lamps R8 (in AJB).

Reverse Signal for aftermarket equipment such as backup alarms may be obtained at Pin 4, on the Trailer Tow 14406 in-line connector, see figure E185973. This circuit is fuse protected to 10 amps.

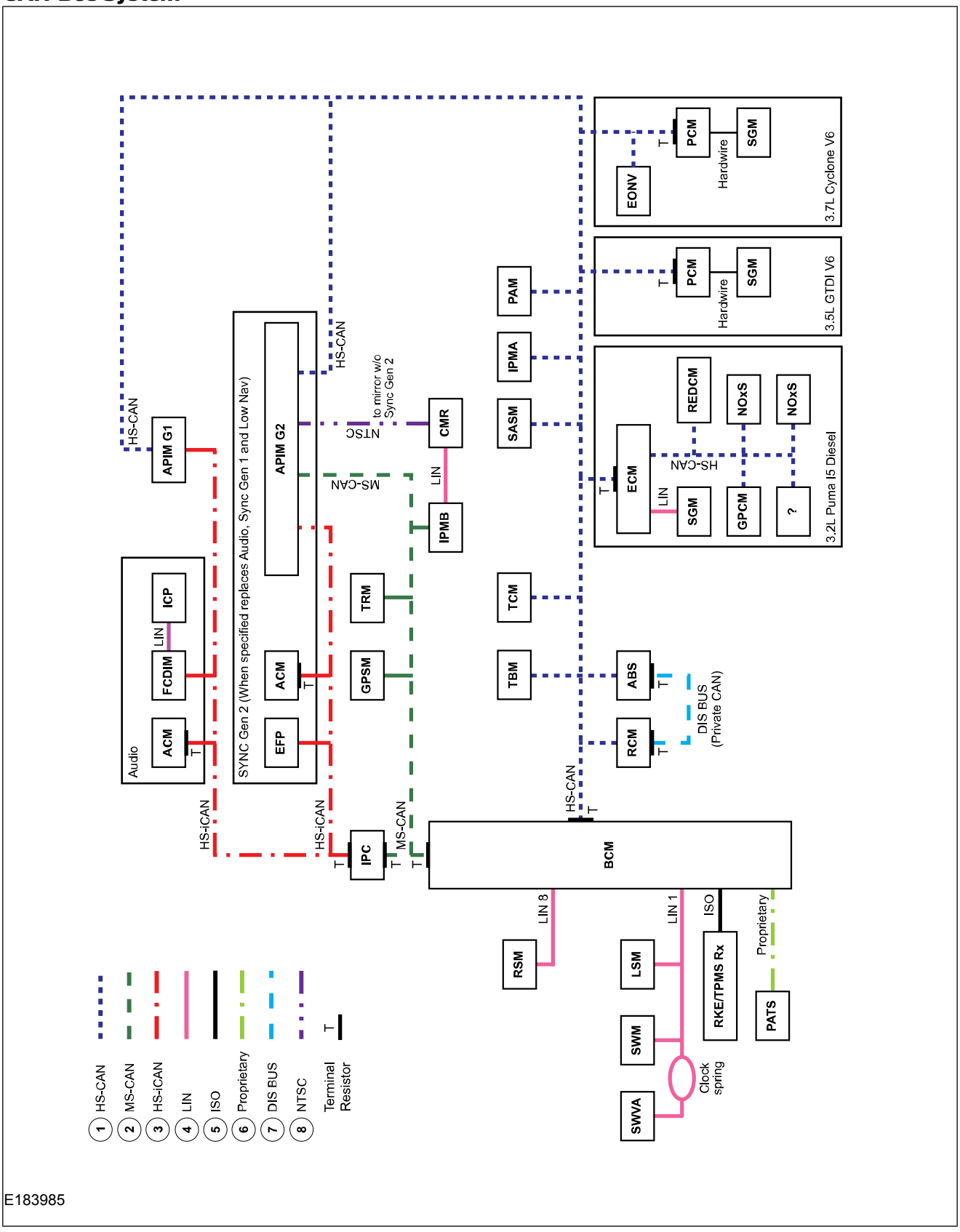
4.2 Communications Network

4.2.1 CAN-Bus System Description and Interface

WARNING: Do not tamper with, cut into or connect to any of the CAN-Bus interface wiring or connectors. The addition of unapproved CAN-Based modules could impact the safe operation of the vehicle.

CAN, Controller Area Network, uses propriety message sets to communicate between the devices shown, via Medium Speed (MS), High Speed (HS), Private and Public Buses. In addition there is localized application of Local Interconnect Network (LIN) and ISO 9141 K-line serial links.

CAN-Bus System



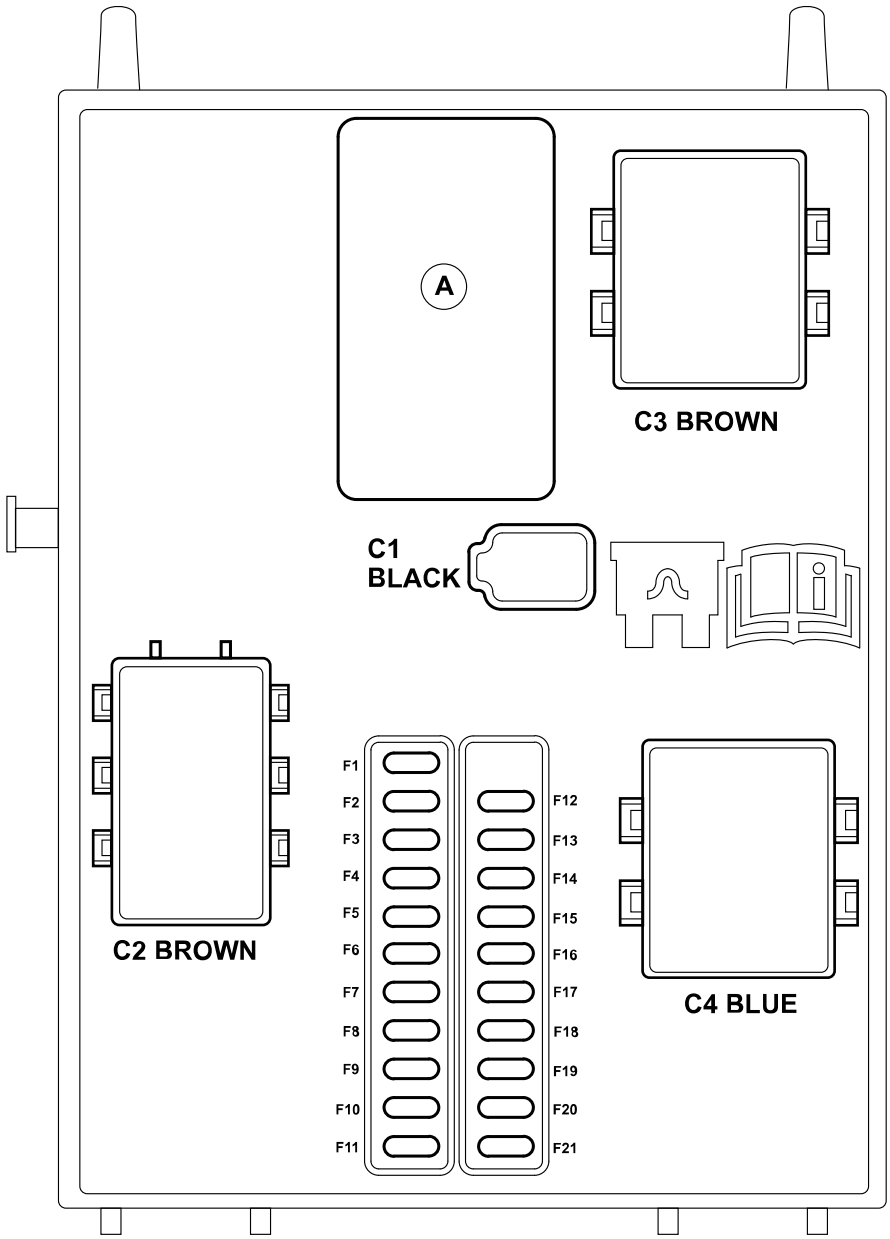
Communication Network System (Figure E183985 references)

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	High Speed CAN	ABS	Anti-Lock Brake System Control Module
2	Medium Speed CAN	ECM	Engine Control Module
3	High Speed iCAN	SGM	Starter/Generator Control Module (Alternator)
4	Local Interconnect Connector (LIN)	BCM	Body Control Module
5	International Standards Organization (ISO)	RCM	Restraints Control Module
6	Proprietary	ABS	Anti-Lock Brake System Control Module
7	DIS BUS (Private CAN)	RSM	Rain Sensing Module
ACM	Audio Control Module - Radio/CD	SWVA	IPMA Steering Wheel Haptic Device (Lane Departure Warning)
FCDIM	Front Control/Display Interface Module (MFD 2,3,5)[1]	SWM	Steering Wheel Module
ICP	Integrated Control Panel	LSM	Light Switch Module
APIM G2	Sync Gen2	RKE/ TPMS Rx	Remote Keyless Entry/Tire Pressure Monitoring System Receiver
IPC	Instrument Panel Cluster	PATS	Passive Anti-Theft System
NOxS	NOx Sensor	SASM	Steering Angle Sensor Module
GPSM	Global Positioning System Monitor	IPMA	Image processing Module A (Lane Departure Camera)
REDCM	Reductive Control Module	PAM	Parking Aid Module
GPCM	Glow Plug Control module	PCM	Powertrain Control Module
TRM	Trailer Module (Trailer Tow)	EONV	Engine Off Natural Vacuum
IPMB	Image processing Module B (Rear View Camera System)	RCM	Restraints Control Module
CMR	Camera Module Rear	EFP	Electronic Finisher Panel

[1] Either low, medium or navigation

4.2.2 Body Control Module (BCM)

BCM - as viewed in-car position



E145367

Item	Description
A	Label Position

WARNINGS:

Unapproved and/or incorrect connection to any of the mating wiring can cause either the associated systems to shut down (overload protection), or permanent damage to the BCM itself.

Vehicle BCM configuration must NOT be modified once the vehicle has left a Ford production plant, except for any changes that may be carried out using dealership integrated diagnostic systems equipment.

The BCM is the prime control module in the vehicle's electrical architecture. It is responsible for management of most of the vehicle's lighting, locking and security systems.

BCM Functionality

Functionality	
Low Series	
Dipped Beam	High Speed and Medium Speed CAN Gateway
Main Beam	Engine Run Signal
Position Lamps	Fuel Pump Control
License Plate	Front Wash Wipe
Brake Lamps	Climate Control Fan Relay Control
Daytime Running Lamps	Switch Back light Illumination (dimming with headlamp switch fitted)
Direction Indicators and Hazard Lamps	Vehicle Horn
Courtesy Lamps	Manual Locking (non power)
Tire Pressure Monitoring System	Washer Fluid Level Sensor
Battery Saver Timer	-
Mid Series (incremental over Low)	
Engine Immobilizer	Configurable Locking (set at time of order)
Power Door Locks	-
High Series (incremental over Mid)	
Heated Mirrors	PTC Heater
Reverse Parking Aid	Automatic Headlamp Control
Perimeter Anti Theft Alarm	Automatic Wiper Control
Rear Window Defrost	Lane Departure Warning
Configurable Locking - Config 7 Config 8 (set at time of order)	-

BCM Output Information

Function	Component	Load Type	Max. Load	Overload Condition
Dipped Beam Left	High Side Pulse Width Modulation	Bulb	1 x 55W	Output Shutdown
Dipped Beam Right	High Side Pulse Width Modulation	Bulb	1 x 55W	Output Shutdown
Main Beam	Relay Output	Bulb	2 x 55W	Blown Fuse — if bigger fuse fitted, relay and/or Printed Circuit Board damage
Position Lamps Left	High Side Pulse Width Modulation	Bulb	23W	Output Shutdown
Positions Lamps Right	High Side Pulse Width Modulation	Bulb	23W	Output Shutdown
Direction Indicators Left	High Side Driver	Bulb	59W/32W [(1)]	Output Shutdown
Direction Indicators Right	High Side Driver	Bulb	59W/32W[(1)]	Output Shutdown
License Plate Lamps	High Side Pulse Width Modulation	Bulb	35W	Output Shutdown
Reverse Lamps	High Side Driver	Bulb	54W	Output Shutdown
Stop Lamp Left	High Side Pulse Width Modulation	Bulb	27W	Output Shutdown
Stop Lamp Right	High Side Pulse Width Modulation	Bulb	27W	Output Shutdown
Center High Mount Stop Lamp	High Side Pulse Width Modulation	Bulb	32W	Output Shutdown
Switch Illumination	High Side Pulse Width Modulation	Bulb	3A@13.5V	Output Shutdown
Battery Saver Supply	High Side Driver	Bulb	105W	Output Shutdown
Front Cabin Lamps	Low Side Pulse Width Modulation	Bulb	75W	Output Shutdown
Rear Cargo Lamps	Low Side Pulse Width Modulation	Bulb	75W	Output Shutdown
Engine Run Status Relay	Low side Relay Driver	Relay	250mA	Output Shutdown
Unlock Relay	High Side Driver	Latch Motor	5A	Blown Fuse — if bigger fuse fitted, relay and/or Printed Circuit Board damage

[(1)]Not combined Stop Turn / Combined Stop Turn. Turn Indicator Supply, smaller loads will cause double flashing

Repeated overloading of circuits can result in output lock-out requiring dealer reset. Repeated dealer resets can result in permanent loss of a function.

BCM Fuse Overview

Fuse	Series	Rating	Function
F1	Mid/High	15A	Central/Configuration Locking 2
F2	Mid/High	15A	Central/Configuration Locking 1
F3	Low/Mid/High	15A	Ignition Switch Supply
F4	Low/Mid/High	5A	Parking Aid Module Source/BTSI
F5	Low/Mid/High	5A	Rain Sensor Supply
F6	Low/Mid/High	15A	Water Pump Supply
F7	-	-	-
F8	-	-	-
F9	Low/Mid/High	10A	Main Beam Right Supply
F10	Low/Mid/High	10A	Main Beam Left Supply
F11	Low/Mid/High	25A	Exterior Lamp Right/Position Lamp Left
F12	-	-	-
F13	Low/Mid/High	15A	On Board Diagnostic II Supply, Battery Saver Supply
F14	Low/Mid/High	25A	Turn Indicator Supply, Heated Screen Pad, Delaved Accessory
F15	Low/Mid/High	25A	Exterior Lamp Left/Position Lamp Right/Roof Mounted Stop Lamp
F16	Low/Mid/High	20A	Radio/CD Navigation Supply
F17	Low/Mid/High	7.5A	Hybrid Electronic Cluster Supply
F18	Low/Mid/High	10A	Light Switch Module, Steering Wheel Module Supply, Stop Lamp Switch Supply
F19	Low/Mid/High	5A	Instrument Control Panel, Multi Function Display Supply
F20	Low/Mid/High	5A	Ignition Passive Anti-Theft Supply
F21	Low/Mid/High	3A	Radio, Hybrid Electronic Cluster, Navigation KL75 Supply

4.3.1 General Information and Specific Warnings

The Transit electrical system is a 12-Volt supply with a negative ground return. The alternator and battery equipment used as standard are designed for normal operations with the type of engine fitted. Higher capacity batteries are available as standard production options and special vehicle options offer AGM technology for heavy PTO and deep cycling applications. Before installing additional electrical equipment check that the battery capacity, technology type, harness load capability, and alternator output are suitable for the extra load.

The battery capacity, technology and charge available from the alternator must be adequate to ensure engine cranking in unfavorable climatic conditions.

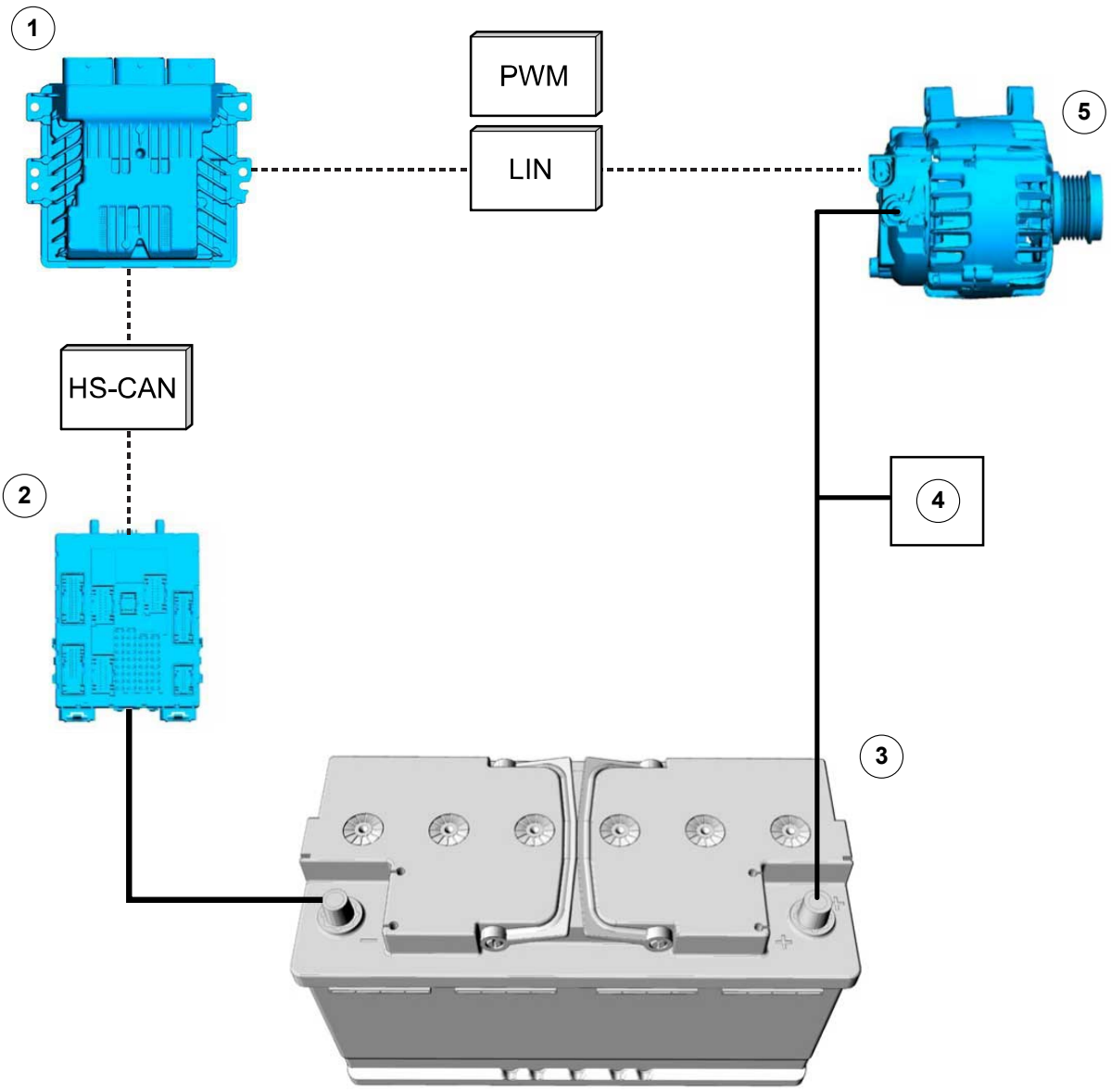
The Transit utilizes multiplexed vehicle electronics, it is recommended that the appropriate Ford proprietary accessory systems are used. Inappropriate or incorrect connection of additional equipment could cause mis operation, or damage to the vehicle, and so invalidate any warranty.

Additional connection points are provided specifically for customer use, and are located on the outside of the driver's seat pedestal. A 60 Amp fused connection is provided as standard.

Do not jump-start the vehicle directly from the battery. Use designated jump-start points. Refer to the Owner's Manual. The wiper motor bracket **must not be used as a ground** as it is isolated from the body.

4.3.2 System Operation and Component Description

System Diagram



Item	Description
1	Engine Control Module (ECM)
2	Body Control Module (BCM)
3	Battery
4	Electrical consumers
5	Alternator

4.3.3 Power Management Settings

WARNING: The only method to return the vehicle to Transport mode is by using a Ford diagnostic service tool with the correct level of security clearance. The Ford dealer has the correct tools and level of security to do this if required.

There are four power management settings available; Factory, Transport, Normal and Crash. Factory and Transport modes are only active with the engine not running (for example: ignition off or with ignition on and engine not running); with engine running, the vehicle operates with full functionality. When in Transport mode, the interior lights, clocks, and power locking and alarms (where fitted) **do not** work.

It is possible to switch from Transport mode to Normal mode without the use of any ancillary equipment, but not vice versa. To change mode, the brake pedal must be depressed five times, and the hazard warning switch operated twice (in any combination) within 10 seconds.

If a vehicle is received from the dealer where modules do not seem to be functioning correctly, please contact the dealer as the vehicle may still be in Transport Mode. Transport Mode is mainly used to conserve battery life/warranty. The normal process is for the pre delivery phase to change the vehicle from Transport Mode to Normal Mode.

4.3.4 Electrical Modifications

WARNING: The fitting of voltage boosters or other devices to enhance alternator output are not allowed, with the exception of DC to DC modifiers, providing the primary side voltage is not changed. The fitting of such devices will not only invalidate vehicle warranties, but could damage either or both, the alternator and Engine Control Module (ECM), and possibly affect vehicle legal compliance. Check local legislation.

Operator requirements for additional and specialized electrical equipment varies. The vehicle modifier must, therefore, consider the following points when designing the installation:

- Legality and regulatory conformity of the base vehicle
- Drive-ability and serviceability of the base vehicle
- The effect of regulations governing the proposed modification including National Legislation in the country of sale
- The method of integrating the circuit into the base vehicle
- No additional circuits are to be run alongside the electrical circuits associated with the Engine Management System (shown in figure E167572), due to the possible inductive or electrostatic coupling of electrical interference
- The base vehicle is equipped with either a single or twin battery system. Additional batteries can be fitted in conjunction with a battery disconnect switch (cut-off relay).

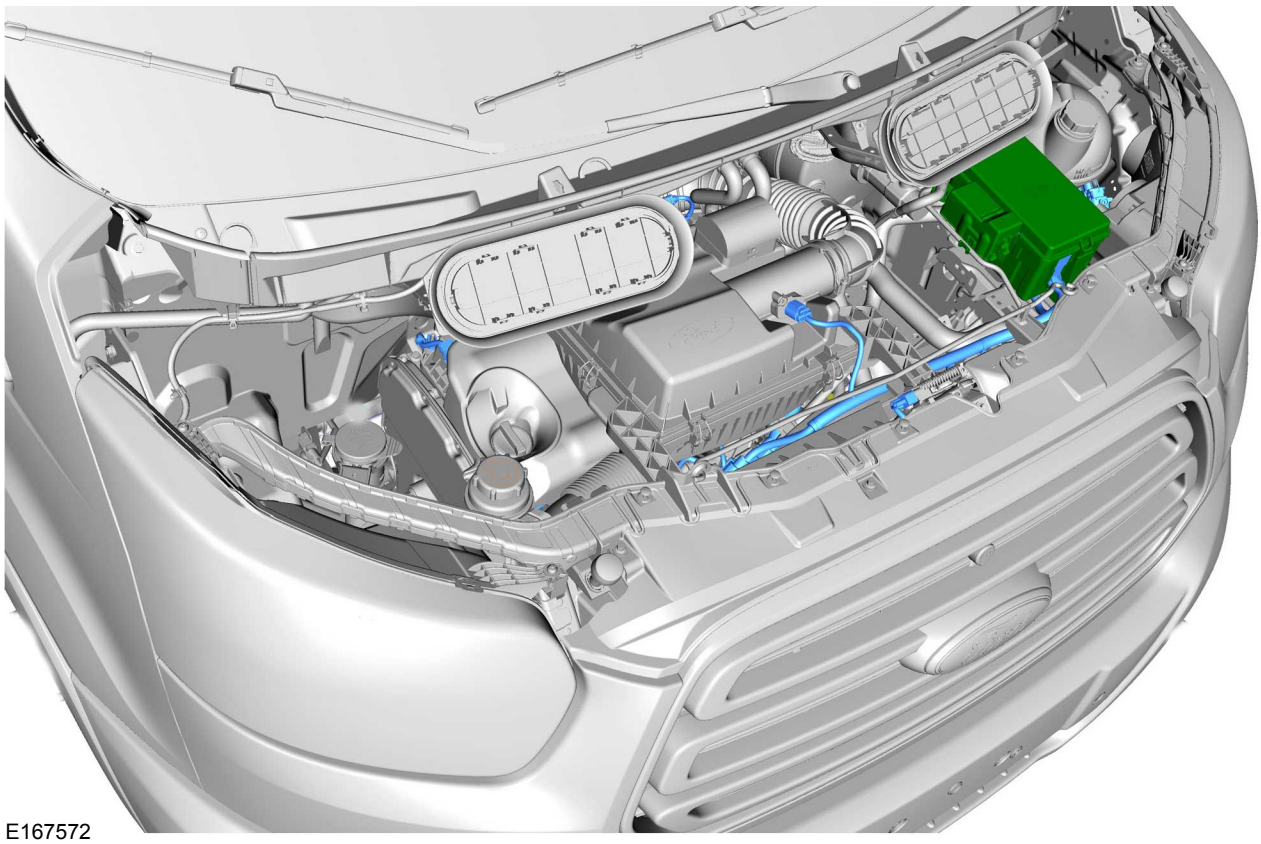
  Refer to: 4.4 Battery and Cables (page 72).
- When auxiliary electrical systems are added to the vehicle, it is recommended that the additional circuits are designed to be used with the Special Vehicle Option Auxiliary Fuse Panel to maintain the integrity of the electrical system.

  Refer to: 4.16 Fuses and Relays (page 124).
- The materials and installation must meet the quality standards described in this section
- Any additional equipment or components must be designed such that they have no adverse Electro Magnetic Compatibility (EMC) effect on the vehicle
- The alternator is PWM controlled for gas engines and LIN controlled for diesel. It does not have a conventional D+ (engine start) signal line.

  Refer to: 4.8 Electronic Engine Controls (page 98).
- Take special care with the routing of existing electrical harnesses within the vehicle to avoid damage when fitting additional equipment. Also see section concerning installation of equipment containing an electric motor

NOTE: For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com

Electrical Circuits Associated with Engine Management System



NOTE: When auxiliary electrical systems are to be added to the vehicle it is mandatory that the additional circuit design includes the necessary fuses.

The Auxiliary Fuse Panel is recommended.

Refer to: 4.18 Electrical Connectors and Connections (page 128).

Safety

Increased use of comfort and safety electronics in modern motor vehicles also requires the greatest attention to be paid during body work. Over-voltages produced during welding and in alignment work during body shell rectification may cause electronic systems to be damaged. In particular, the safety instructions for performing welding / cutting work on vehicles with airbag systems must be adhered to.

NOTE: After disconnecting the power supply and before performing further work, a wait time of up to 15 minutes must be maintained, depending on the vehicle. Work on airbag systems may only be performed by persons who have a relevant certificate of competence.

Pay attention to the following points:

- Disconnect all the batteries, including ground and insulate the negative battery terminal(s)
- Disconnect the electrical connector at the airbag control module
- Disconnect the alternator multi-plug prior to using welding or cutting equipment
- If welding or cutting is to be performed directly near a control module, it must be removed before hand
- Never connect the negative cable of the welder near an airbag or a control module
- Connect the negative cable of the welder close to the location of the weld

4.3.5 Fitting Equipment Containing Electric Motors

WARNING: When electric motors are to be fitted, account must be taken of the potentially high in rush currents that a motor can draw.

CAUTION: The following must be observed:

- All motors must be driven via relays with contacts rated at least 3 times the maximum rated current of the motor
- All motor supply circuits must be individually fused with the proper fuse rating for the motor
- All power wiring must be rated for at least 3 times the rating of the motor and installed as far away as possible from any existing vehicle wiring
- All motors fitted should be fully suppressed to meet regulations relating to Electromagnetic Compatibility to ensure electrical interference does not affect the vehicle systems
- Add EMC emissions statement to CE approval

4.3.6 Vehicle Electrical Capacity — Alternator

WARNING: Do not cut into the alternator wires. The alternator is PWM controlled for gas engines and LIN controlled for diesel. It does not have a conventional D+ (engine start) signal line.

4.3.7 Charge Balance Guidelines

The base vehicle is fitted with a 150A alternator. It is recommended to conduct a charge balance calculation in case the modification comprises a high number of electrical consumers or high electrical consumption is expected.

4.3.8 Circuit Diagrams

For circuit diagrams for Auxiliary Fuse Panel connections and standard Ford relays.

Refer to: 4.18 Electrical Connectors and Connections (page 128).
Refer to: 4.16 Fuses and Relays (page 124).

Full vehicle wiring and circuit diagrams are in the Ford Workshop Manual.

NOTE: Detailed electrical schematics and workshop manuals are available from the FCSD/Motorcraft website.

4.4 Battery and Cables

4.4.1 Power and Connectivity Usage Recommendations

NOTE: Use AGM Batteries for deep cycle applications i.e. charge and discharge on a regular basis.

NOTE: · When considering battery discharge, the modifier needs to consider the current drawn when the added system is in operation, plus any continuous key off loads even when not in use. For example, an inverter fitted will consume power even with no load connected.

NOTE: · Where possible, engine run operation of electrical equipment reduces battery discharge; both Vehicle Start and Auxiliary Batteries are utilised in conjunction with the charging system.

NOTE: · User training and appropriate battery maintenance on a regular basis will assist in ensuring correct battery operation.

Power Usage	Recommended Specification
Occasional electrical loads less than 30A at engine run, and less than 5mA at key off. For example: Courier Van or Hotel Transfer Bus where occupants use interior lamps and power points for charging laptops, phones or portable navigation systems.	Standard Power Supply with the vehicle, single or twin batteries, with standard 150A alternator is acceptable.
Electrical loads greater than 30A at engine run, or, greater than 5mA but <100mA at key-off over a long duration. For example: Maintenance Van with power tools, water heater, and additional lighting.	Twin High Performance Deep Cycle AGM batteries with standard 150A standard alternator. Note: if loads are used over a long duration with the engine running, it is recommended that the base vehicle be ordered with the heavy duty alternator option.
High electrical loads for short duration (100 - 250A requirements). For example: rear lift gate, communications, beacons	Twin High Performance Deep Cycle AGM batteries with standard 150A standard alternator. Note: if loads are used over a long duration with the engine running, it is recommended that the base vehicle be ordered with the heavy duty alternator option.
For application of high electrical loads for frequent duration (100 - 250A) or greater than 100mA at key-off over a long duration. For example: ambulances	Supplemental Deep Cycle AGM batteries on a split charge system. See Modifier third party battery section.

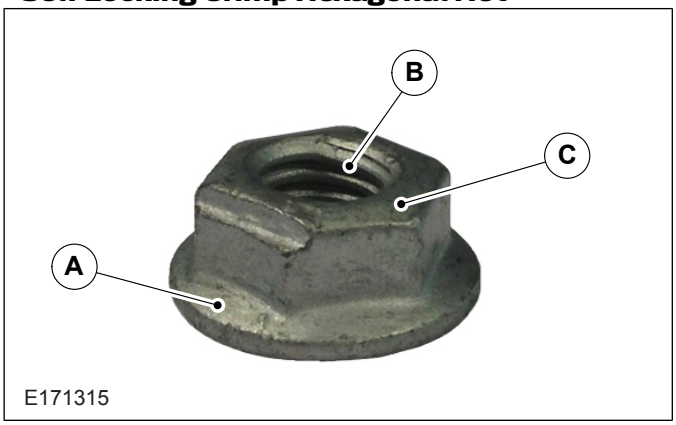
4.4.2 High Current Supply and Ground Connections

WARNINGS:

A self locking crimp hexagonal nut MUST be used for high current terminal stud connections, for battery positive and negative or chassis ground. Do not use locking, split washers or nylon lock type nuts.

It is recommended to only use one eyelet per stud for high current applications. If more than one eyelet per stud is unavoidable, the highest current eyelet feed should be connected closest to the supply terminal. Do not exceed two eyelets or crimp terminals per stud connection.

Self Locking Crimp Hexagonal Nut



Item	Description
A	Large flange for maximum surface area current flow and large clamp force area.
B	Crimp/locking feature is obtained by deformed female thread only
C	Finish must be a low resistance material which complies with the Restricted Substance Management Standards (RSMS).

4.4.3 Battery Information

WARNINGS:

For electrical power take-off that requires deep discharge and cycling from third party systems, twin High Performance Deep Cycle AGM batteries must be ordered on the base vehicle. If twin High Performance Deep Cycle AGM batteries are not on the base vehicle they can be fitted by your local Ford Dealer.

If serviceable batteries are fitted, it is essential that regular checks are made to determine that the electrolyte (acid) levels are correctly maintained. There is a level indicator in each cell.

Take necessary safety precautions when handling batteries, for example: protective clothing, eye and hand protection.

Ensure batteries are charged in a designated charging area that is correctly ventilated.

NOTE: If a modifier intends to add systems or accessories that will add significant electrical load (particularly at key off), then vehicles with twin High Performance Deep Cycle AGM batteries should be specified. The twin option is the standard heavy duty system for loads greater than 5mA continuous at key off or 30A at engine run. It is also recommended to upgrade to the heavy duty alternator option if the extra loads are continuously active at engine run and exceed 30A above standard Ford systems.

In order to protect the battery system from direct ground shorts or continuous high current loads, a 470A fuse is fitted in the Pre Fuse Box under the driver's seat. Modifier fit peripherals must not use this fuse as its sole purpose is protection of the starting and charging system.

This fuse is not repairable — Use only a Ford replacement part.

Following battery disconnection, there is no need to reprogram the vehicle. It retains its 'normal' power management settings and configurations. However, the central locking latches may cycle if one of these was opened manually in the intervening period. With regard to the radio, all of the settings are retained.

There is no longer a need to re-program the electronic security code, as it is tied into the VIN of the factory fit Transit system. The clock initializes to 1200 and will need to be reset to correct time in accordance with the owner's guide procedure.

After market battery management systems are not required unless for modifier fit equipment or third party battery low voltage protection.

WARNING: Where a battery guard is fitted, the supply from a non-deep cycle standard single flooded battery system (1x70Ah) should not be set below 12.3V at open circuit voltage. If a battery guard is monitoring a supply from a deep cycle twin AGM battery system (2x70Ah), it is recommend not being below 11.85V at open circuit voltage. If the supply has different configuration, it is recommended to test the Low Voltage Threshold to ensure crank capability. There will be volt drop if the system is under load. It is recommended to test the volt drop under the load and compensate for the volt drop to avoid early disconnect. For example: loads above 20A will cause approximately 0.3V drop in the twin AGM battery system. If the system is under load above 20A the Low Voltage Threshold can be set to 11.55V. If a battery guard is required because equipment can be active at engine off, then it is recommended to fit deep cycle batteries as standard. See also 'Power and Connectivity Usage Recommendations' table later in this section. A battery guard high voltage set point should also not be below 15.3V as this is the normal operation voltage of an SRC system, when in refresh mode. For full peripheral robustness, it is recommended that equipment can handle up to 24V to allow for accidental jump start by extra 12V supply in series and not parallel.

Where twin batteries are required on vehicles with a single battery installation, associated wiring and hardware should be fitted and aligned to Ford architecture. The extra battery must be of the same technology and performance rating as the existing battery.

If the battery type on a vehicle is changed to other compatible derivatives (see battery configuration table) it is required to reconfigure the vehicle to the new battery types from the dealer. Central car configuration can be updated at a dealership.

For special modifications requiring a third party battery, a further disconnect switch is recommended. This should be controlled via the engine run signal to a normally open relay. A schematic of this architecture can be found later in this section.

Refer to: 4.8 Electronic Engine Controls (page 98).
and
Refer to: 4.3 Charging System (page 67).

Battery Voltage Requirements and Testing

To maximize battery life, at the time of arrival at the vehicle modifier, all batteries must have a minimum Open Circuit Voltage (OCV) of not less than 12.5V. When the Closed Circuit Voltage (CCV) is applied, the voltage must not be less than 12.4V. This applies to any of the Ford battery technologies used and applies to both batteries if a twin system.

All voltages are to be measured with an accuracy of: ± 5% of values published using calibrated meters.

Surface Charge Dissipation

Prior to carrying out manual voltage checks, it is necessary to establish that the battery does not have any damage and the battery voltage is stable and free from surface charge which occurs after engine run.

To ensure surface charge is not present measure the battery voltage after the vehicle has been standing, with the engine off and no loads active, for a prolonged period of 24 hours. If this is not possible an estimate can be made using the following method:

1. Turn the ignition key to position II and switch on the headlamps (main beam) rear window demister and the heater blower motor (on position II). Leave the vehicle in this condition for at least 1 minute to dissipate what ever surface charge is present in the battery.
2. Turn the ignition key to position 0 and switch off the loads; headlamps, rear window demister and heater blower motor. Leave the vehicle in this condition for at least 5 minutes, before taking a battery voltage reading.

Delayed Vehicles

Vehicles held at the vehicle modifier premises and not in use for longer than 7 days, should have the battery's negative cable disconnected. Before shipping to the customer, the battery negative cable must be re-connected and the voltage re-checked. A complete recharge for battery voltage below 12.4V and or for no-crank vehicles by using appropriate charge.

For additional information

Refer to: 1.9 Vehicle Transportation Aids and Vehicle Storage (page 15).

Battery Charging Procedure

WARNING: Do not connect to any Ground or +12 volt potential points other than that specified in the Owner's Manual. There is a dedicated charge point under the hood. Failure to comply may lead to high current paths that may damage peripherals and ECU's especially in a jump start condition.

1. Cold batteries will not readily accept a charge. Therefore, batteries should be allowed to warm up to at least 5ºC (41ºF) before charging. This may require four to eight hours at room temperature depending on the initial temperature and battery size.
2. A battery which has been completely discharged may be slow to accept a charge initially, and in some cases may not accept a charge at the normal charger setting. When batteries are in this condition, charging can be started by use of the dead battery switch or boost charge on chargers that have this facility.
3. To determine whether a battery is accepting a charge, follow the manufacturers instructions for the charger, for use of the dead battery/boost charge mode.

Battery Cable Fixing Torque

The battery cables should be fixed to the terminal positive and negative posts with a torque of 8.0 Nm ± 1.2 Nm.

Battery Options

Battery Type and Usage

Type	Quanity	Size
Single Battery Battery Configuration A		
610 CCA (70Ah @ 20 hour rate) Standard Flooded Battery	1	H6
Single Battery - Deep Cycle AGM Battery Configuration A		
760 CCA (70Ah @ 20 hour rate) Absorbent Glass Mat Battery	1	H6
Twin Batteries - High Performance Deep Cycle AGM Battery Configuration B		
760 CCA (70Ah @ 20 hour rate) Absorbent Glass Mat Battery	2	H6

4.4.4 Battery Rules

- Batteries in parallel must be of the same type and capacity
- Third party batteries and loads are isolated from the standard Ford system at key off
- For External charging of batteries ensure that the maximum voltage of 15.2V is not exceeded. Normal proprietary charging equipment should operate below this voltage
- For deep cycling and micro cycling requirements (engine off loads) the deep cycle battery system (A737) is recommended

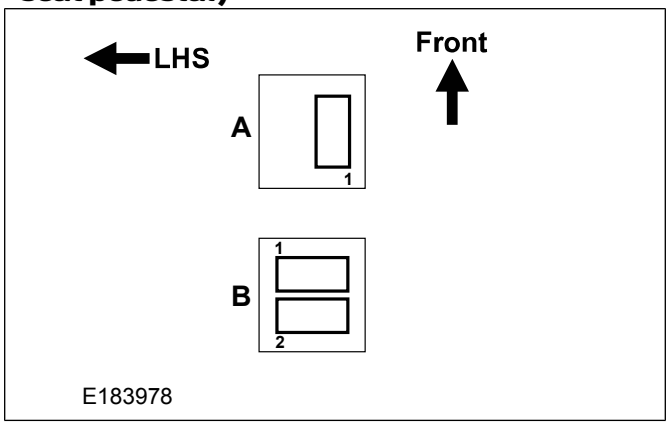
NOTE: Charge balance calculations are required when adding additional systems, taking into account alternator size and battery capacity.

Important Factors for Battery Choice

- Battery specification capability in ampere hours for continuously loading until empty. For example: an 80Ah fully charged battery can supply 4.0 Amp over a 20 hour period at 20°C until it is fully discharged
- The Cold Crank Ampere (CCA) rating is the maximum rating for cold start requirements

4.4.5 Battery Configurations

Battery Configurations (always in the drivers seat pedestal)

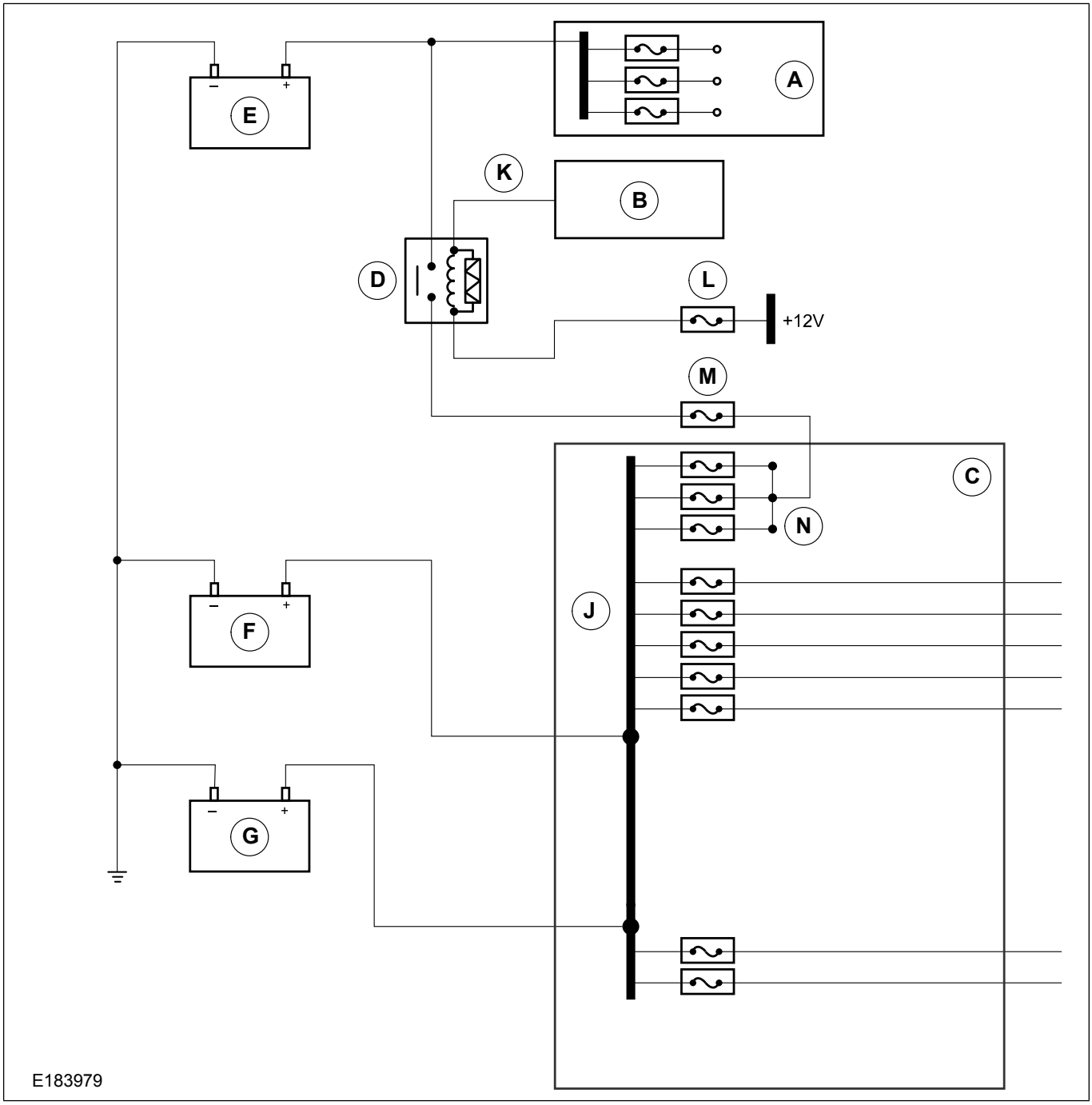


Battery Configuration

Item	Description
1	Battery 1
2	Battery 2
A	Single standard battery system
B	Twin High Performance Deep Cycle AGM battery system

4.4.6 Modifier Fit Additional Third Party Batteries and Peripherals

If additional batteries are added, a disconnect relay or main switch system is advised to isolate the modifier fit battery from the Ford fit batteries. It is recommended to only connect the third party battery to Ford fit batteries and alternator at engine run. If supplemental chargers are added for the third party modifier fit battery, direct connection of such chargers to this battery is required. Gel batteries in particular are vulnerable to multiple starter cycles, see figure E183979 for an example of modifier fit third party battery installation to existing Ford power supply architecture.



ITEM	DESCRIPTION
A	Modifier Fit — Loads
B	Body Control Module — Provides Engine State
C	Pre Fuse Box — Drivers Seat Pedestal
D	Modifier Fit — Normally open Third Party Battery Control Relay
E	Modifier Fit — Third Party Battery
F	Ford Fit — Battery 2
G	Ford Fit — Battery 1
J	Ford Fit — Loads (from Auxiliary Battery)
K	Switched Ground Engine Run Signal (200mA)
L	Modifier Fit — +12V Fused KL30 Supply
M[(1)]	Modifier Fit Power Supply Fuse
N	Customer Connection Points - 1x 60A standard, maximum of 180A depending on vehicle configuration

[(1)]= Modifier fit power supply fuse may not be required if customer connection points are the correct value.

4.4.7 Additional Loads and Charging Systems

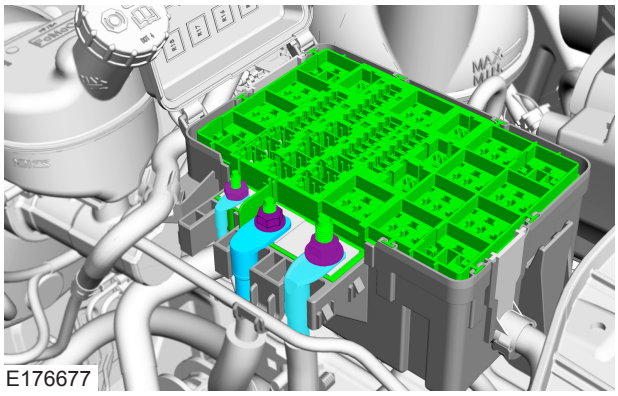
WARNING: Do not make any additional connections directly to any of the vehicle's battery terminals, unless an auxiliary stud is fitted.

Any electrical loads should be taken from the customer connection points.

Refer to: 4.18 Electrical Connectors and Connections (page 128).

NOTE: Do not make any additional connections to the Engine Junction Box (EJB) terminals, as over-torqueing could cause damage to the EJB.

EJB Terminal Studs



All loads that exceed 80mA continuous key off load must be fitted with an isolation switch or disconnected relay. In general all loads should have some form of isolation. A supplemental battery may be required to power systems, for example: GPS vehicle tracking systems, that pull high key off loads continuously. This is to protect from discharging batteries at ignition off. This supply should also have a dedicated protection fuse of the correct value. High loads should also be grounded directly to the vehicle body and not the negative battery terminal.

4.4.8 The Ford Programmable Battery Guard

WARNINGS:

The Ford Programmable Battery Guard (FPBG) is not designed for long duration engine run power for loads greater than 70A. The system is mainly designed for engine off short duration heavy loads, or long duration low loads with the protection by isolation to allow enough energy to still crank the engine. The guard can still provide engine run power to provide high current short duration, charge systems such as third party batteries and systems such as inverters but only for amperage versus time durations as described further in this section.

If the vehicle does not come with the 240A alternator, or longer duration is required at the amperage above values further in this section, then a dedicated alternator and power cabling must be applied to avoid saturation to the Ford alternator and any thermal issues on vehicle wiring and related systems. The table described in Power and Connectivity Usage Recommendations also applies when to upgrade alternators and batteries.

NOTE: FPBG is not available until 2018MY, for availability please contact your National Sales Representative or your Local Ford Dealer.

FPBG is not available with relocated handbrake.

System Overview

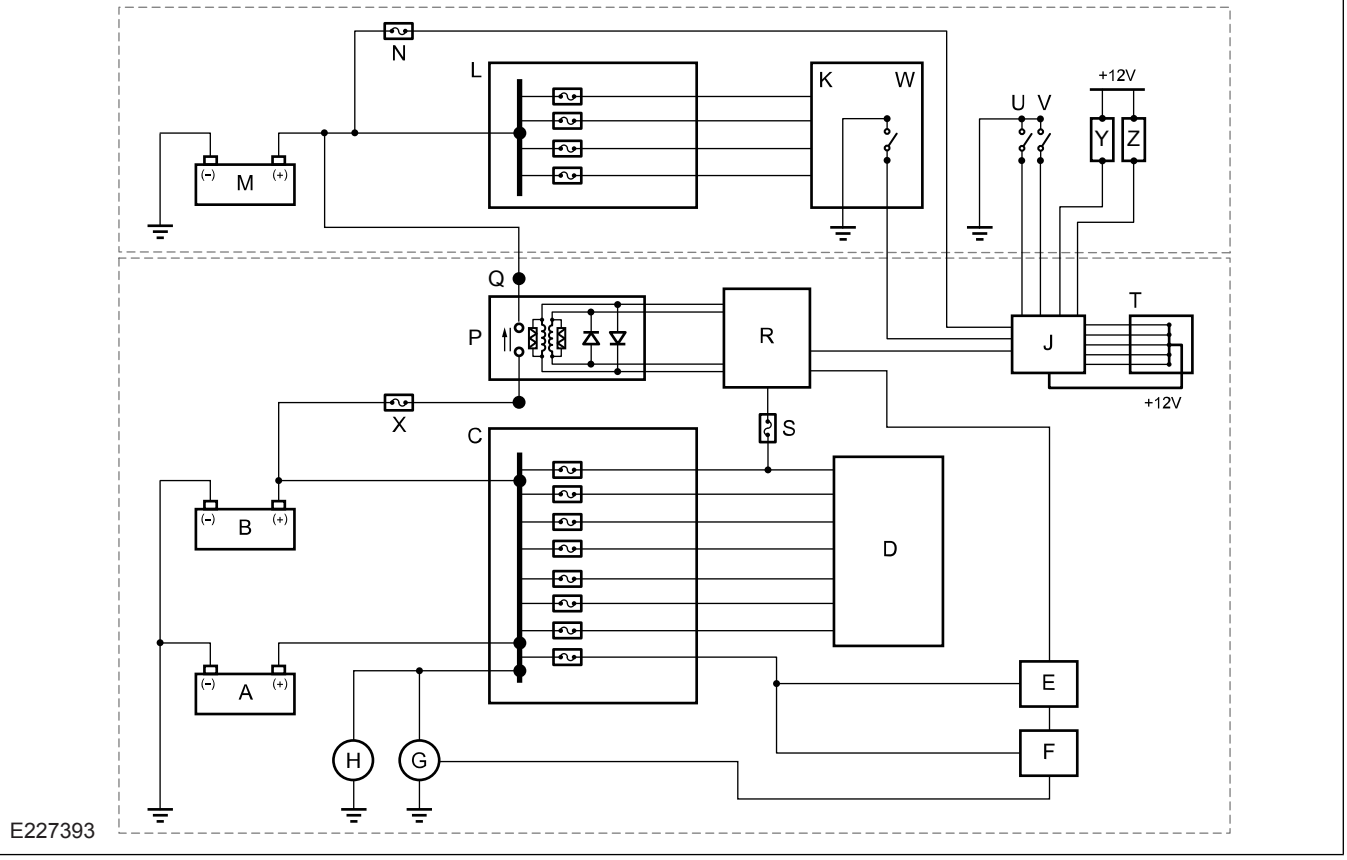
The Ford Programmable Battery Guard (FPBG) is a production or service fit system which provides 175A fused 12V power for customer use at any engine or ignition state. The system can be down-rated depending on the Mega fuse range available, changed by the modifier.

Main System Benefits Include:

- Intelligent control of power, by isolating the 175A power to third party systems, protects the vehicle`s crank capability. Fuse values can be lowered, if required
- Third party batteries can be connected and monitored including charging where required
- Easy setup operation mode (1 to 8) setup for the battery configuration and time duration power requirements at engine off
- Protects Ford battery State of Charge (SOC) by isolating the power relay when a low voltage is detected or a specific time point is reached
- Provides warning signals prior to timed or required power shut down
- Immediate relay close function to receive emergency power, after auto disconnect, for a limited period of time
- Immediate relay close function to override mode timers for extended engine off usage on low current devices
- Immediate relay open function to isolate third party system when isolation is needed
- Load Active Pin provides longer Engine Off usage duration for currents above 20A while still protecting the crank capability
- Will provide a charge to all batteries when detecting a mains charger applied to one of the batteries, at engine off
- Will protect third party batteries, particularly leisure type GEL batteries from crank cycles and only use energy if required
- Provides a warning that a mains charger is still connected to the vehicle if the system sees an ignition state change to start the engine
- Reduce fuel usage and emissions from less charging time due to mains charging and efficient isolation of third party system

- Improves third party battery warranty as system will now monitor the state of charge of the third party battery and protects from the majority of engine crank cycles
- Will provide continuous power at engine off if mains charger applied by manual switch demand

Overview of System



Item	Description	Item	Description
A	Ford Battery - Standard	N	Third Party Battery Voltage Sense Line Fuse
B	Ford Battery - Standard/Optional	P	Power Relay[1]
C	Ford Power Distribution	Q	Power Relay Terminal - Third Party Power Connection
D	Ford Vehicle Load	R	Module*
E	Body control module (BCM)	S	Ford Battery Voltage Sense Line Fuse[1]
F	Power Control Module (PCM)	T	Mode Wires[1]
G	Alternator	U	Immediate Relay close
H	Starter Motor	V	Immediate Relay Open
J	FPBG Interface Connector[1]	W	Third Party Load Active
K	Third Party Loads	X	Mega Fuse[1]
L	Third Party Power Distribution	Y	Status Indicator
M	Third Party Battery	Z	Power Isolation Warning

[1] = Ford Programmable Battery Guard (FPBG). See figures E227390, E227391, E227392, E227394, E252619 and E257003.

Modes and Set Up

NOTE: Where a third party battery is fitted, and directly coupled to a third party device, it is recommended that a deep cycle type battery be installed such as AGM (Absorbent glass matt) or GEL technology. Due to the resilience of AGM technology, these batteries will work in any mode. The timer duration will be met providing the system voltage stays above the cut off threshold. However, if the voltage value is below the set point within the timer value, isolation will occur at 60 seconds after the minimum voltage is reached.

NOTE: The modes in the following table are a guide. It is not recommended to go below 12V with a single standard flooded battery. If an incorrect battery or mode is selected the timer duration may never be achieved and extra fuel (engine run time) be required.

Battery Quantity, Type and Timer Modes

Mode	Ford Battery	AH	Minimum Voltage (V)	Key Off Time (Minutes)
1	Single Standard Flooded, No Third Party Battery	70	12.3	30
2	Single Standard Flooded, With Third Party Battery	70	12.3	60
3	Single AGM, No Third Party Battery	70	12.15	60
4	Single AGM, With Third Party Battery	70	12.15	120
5	Twin AGM, No Third Party Battery	70 x2	11.85	90
6	Twin AGM, With Third Party Battery	70 x2	11.85	180
7	Twin AGM, No Third Party Battery	70 x2	11.85	No timer & Uninterrupted
8	Twin AGM, With Third Party Battery	70 x2	11.85	No timer & Uninterrupted

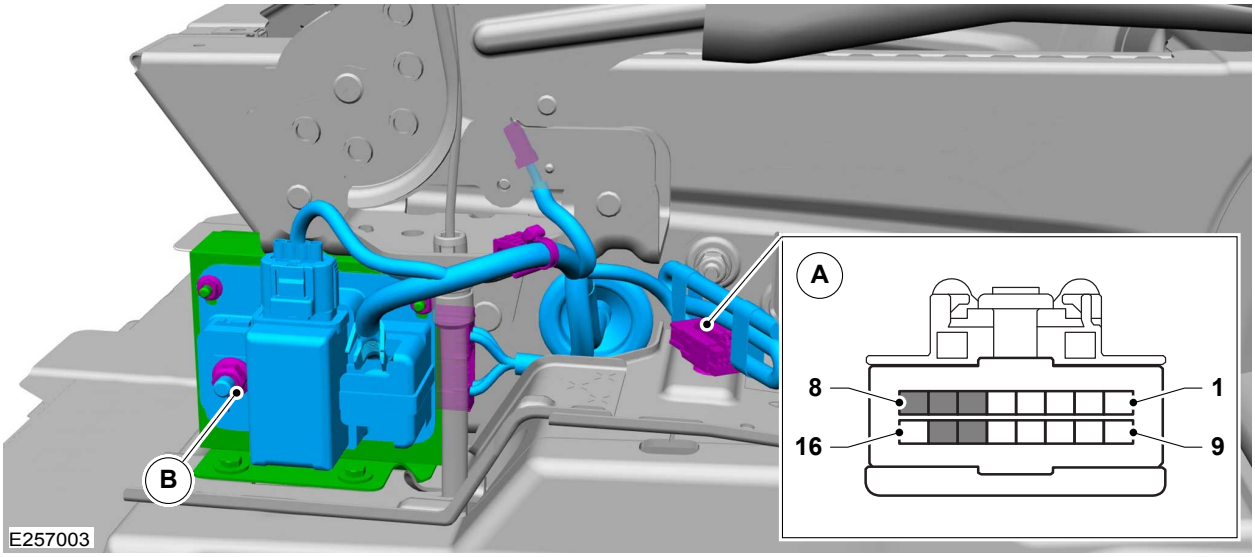
Set Up

1. Locate FPBG Interface Connector, under the parking brake console, see figure E257003.
2. Find the System Mode Pins 15,14,8,7,6,in the FPBG Interface Connector, see figure E257003.
3. Refer to the Battery Quantity, Type and Timer Mode table and configure the required mode. Cut and isolate pins where shown as OFF in the Mode Configuration Pin table. For example: If Mode 8 is required, cut wire and isolate to pin 15,14,8 and 6.

Mode Configuration Pins

Mode	Pin 15	Pin 14	Pin 8	Pin 7	Pin 6
	Black Wire	Red Wire	Blue Wire	Green Wire	Gray Wire
1	ON	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF
5	ON	OFF	ON	OFF	OFF
6	OFF	ON	ON	OFF	OFF
7	ON	ON	ON	OFF	OFF
8	OFF	OFF	OFF	ON	OFF

FPBG Interface Location

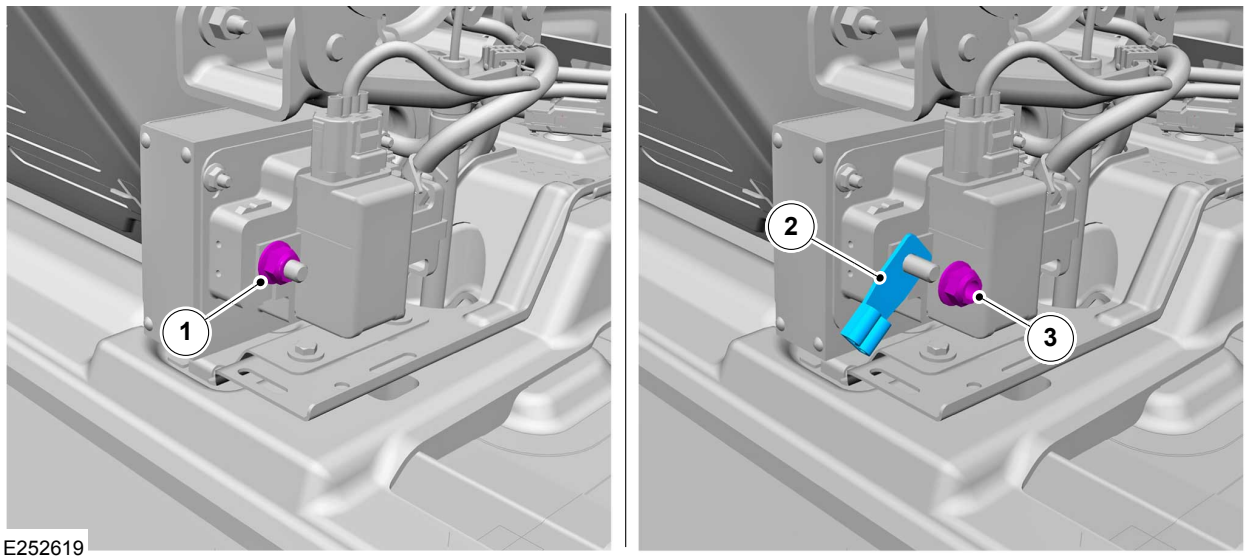


Item	Description
A	FPBG Interface Connector
B	Power Relay Terminal (B)- Third Party Power Connection (+12V)

FPBG Interface Connector Pin layout

Pin	Description	Wire Color
1	Close Relay Request Input - SW GND	Yellow/Gray
2	Open Relay Request Input - SW GND	Blue/Red
3	Empty	-
4	B+ Upfitter Battery Sense Line	Black/Gray
5	Empty	-
6	Mode Configuration Pin 6	Gray
7	Mode Configuration Pin 7	Green
8	Mode Configuration Pin 8	Blue
9	Load Active Input	Blue/Gray
10	Empty	-
11	Power Isolation Warning	Black/Yellow
12	Status Indicator / Diagnostics	Gray/Orange
13	Empty	-
14	Mode Configuration Pin 14	Red
15	Mode Configuration Pin 15	Black
16	Ignition KL15 +12V	Gray/Yellow

FPBG Power Relay Terminal - Third Party Power Connection (+12V)



1. Remove M8 Nut
2. Place Third Party Power Cable Eyelet onto M8 Stud
3. Secure M8 Nut to Torque 12Nm ±1.8

Function

Low Voltage Cut off – Engine off: The system will disconnect power when voltage is sensed below the mode threshold value (11.8V or 12.3V). The system will only disconnect if the low voltage is below threshold for 60 seconds continuously. The system will keep the relay contacts open until a key cycle occurs or a voltage increase is detected (for example: an external charger applied) above the low set point threshold.

External Charger – Engine off: The system will close the relay contacts if a voltage over 13.1V is detected in the system (an external charger is added to the Ford or third party battery) for 8 hours to provide a charge to all batteries in the system. Manual override can be done by keeping Immediate Relay Close Pin grounded during the period when continuous power is required. A third party fit latched switch type would achieve this functionality. When a low voltage condition is detected on Ford battery system in modes 2,4,6,8, relay will not be opened if third party battery system has voltage higher than defined threshold.

Low Voltage Cut off – Engine on: The system will close the relay contacts when an engine run is detected and the voltages prior to crank event was higher than the threshold value. Isolation of the relay, will occur immediately when the ignition signal is detected, if a mains charger is connected to the system prior to the crank event. A warning will also be given via the Status Indicator circuits. It is up to the modifier as to decide whether third party visual or audible warning devices are fitted to the signal.

Load Active Input - Engine off: Load Active Input allows longer Engine Off usage at currents above 20A by reducing the cut off voltage threshold of the Modes. When the Load Active Input is turned on the cut off threshold is set 0.3V lower than the actual Mode threshold. At Engine Off, when the input is applied whilst load is active, a new threshold will be set and relay will stay connected until the new threshold is reached. For Example: Mode 7 has 11.8V Mode threshold value. If the Load Active Input is activated at Engine Off, the new threshold will be 11.5V. The user can continue using battery power until voltage goes below 11.5V. This is the closed circuit voltage under loads above 20A, therefore when the cut-off happens, open circuit voltage will be observed to recover. The lower calibration is required to compensate for load versus actual battery state of charge. To reduce the risk of early Power disconnect, the load feature must be utilized for peripheral continuous loading above 20A. Repeat usage of ths function without charging the batteries will lead to shorter usage duration and may lead to a failed crank.

Power Isolation Warning: The system provides a Power Isolation Warning at the dedicated output. This is a switched ground output and requires a third party audio or visual device to be fitted, such as an LED lamp or buzzer installed and is activated prior to main supply disconnect.

The value of this output is a low side driver rated at 1000mA. This is to provide early warning that the supply is imminent for disconnect and gives a chance to restart the engine, add a mains charger or finish their power usage task.

Power Isolation Warning output will be given when voltage is sensed to be under the voltage threshold value for 30 seconds.

This assessment is required to ensure there is no instant voltage drop in the system because of an initial start of high power equipment or cranking.

The Power Isolation Warning output will be continuous until the 60 seconds completed under threshold and relay is already open circuit. This allows the operator to understand why they have lost power. In extreme power take off events, but with a good state of charge of battery, there may be events when the warning is triggered but disconnection does not occur, if the load is removed within the trigger period due to the battery recovering voltage above the cut off threshold. This is normal operation and further loads could be applied before an engine start and charge is required.

Power Isolation Warning output will also be given when key off timer is in the last 30 seconds.

Status Indicator: The system provides a Status Indicator output which is the indication of the system status on certain functions. The value of this output is a low side driver rated at 1000mA. This is a switched ground output to be used by third party audible or visual device, such as an LED lamp or buzzer.

Status Indicator output will be given when an Immediate Relay Contact Close switch(third party switch) is detected to be on. The output will be continuous as long as the Immediate Relay Close is active.

Status Indicator output will also be given when Ignition is detected if the voltage is higher than external charger voltage threshold 13.1V. This is to give the warning that external charger is still on before the crank and user should check the cable connections. The warning will be given as a pulse signal 500ms ON 500ms OFF. Output will be stopped after 30seconds regardless of the engine state.

Status Indicator also gives output with a dot-space matrix pre-defined set of functions when related conditions occur. The set of conditions are shown in Diagnostic section.

Immediate Relay Contact Close Feature: If immediate Relay Contact Close signal is activated via a momentary pulse, it will immediately close relay contacts. This overrides all other functions of operation at engine off for 2 minute duration except the Immediate Relay Contact Open. After 2 minutes, the system will go back to normal operation monitoring providing the signal is inactive. If a switch cycle is detected, another 2 minute power is provided.

If immediate Relay Contact Close signal is activated continuously via a latched switch, it overrides the key off timer providing the batteries in the system are above the low voltage threshold. The relay contacts will stay closed until the batteries go below the low voltage threshold. This may be used to extend engine off power duration, however, it is not recommended to use the feature permanently. There will be a disconnect if ignition position 2 is selected, for example during a crank event. See Cold Crank Aid in this section of the manual. Contact VCAS@ford.com for system specific questions if uninterrupted power is required.

Immediate Relay Contact Open: If OPEN relay signal is activated, it will immediately open relay contacts and override all other functions until next key ignition cycle and the switch is deactivated. When a new key cycle is detected (Ignition Position 0 then 2), the module will go back to normal operation. If the signal is still activated regardless of ignition state, the relay contacts remain open. This system should not be used as an emergency stop. A separate emergency stop for safety critical systems must be included in the third party system.

Over-Voltage Protection: When a voltage above 15.5V is detected the system will send open contact signal if the voltage is below 15.8V. The module then stops sending outputs until voltage recovers below this voltage upper limit.

When voltage is detected above 15.8V the system will still understand voltages up to 17.4V but will not send any outputs. Diagnostic LED will light continuously RED-RED-ORANGE sequence in Over-Voltage when it is higher than 15.8V.

Sleep Mode: The system will be active when it sees ignition position 2 signal from position zero or key out. When ignition position 2 is deactivated, the key-off operation timer starts where it will monitor voltages and continue normal operation for a timed period set, depending on which MODES from 1-8 are set. The module will go to Sleep mode after 10 minutes from the timer duration period or low voltage cut off point. To wake up the module, the following conditions need to occur, either: Ignition state change back to position 2, Battery Voltage increase or Immediate Relay Contact Close.

Cold Crank Aid and Third Party Battery Starter Motor Protect: The system will keep the relay contacts open after ignition position 2 is detected until it receives the engine run signal unless crank does not initiate within a 30 second period. When engine run signal is received within the first 30 seconds, the system will close the relay contacts immediately if modifier battery is above the low voltage threshold set point. If the third party battery is below the threshold voltage set point, the system will activate SRC inhibit after engine run and close the contacts 5 seconds later. If the system detects a second ignition position 2 cycle without engine run within the first 30 seconds, it will immediately close the contacts for 30 seconds. This is to provide supplemental crank energy from the third party battery whilst not always exposing the third party battery to the starter motor inrush current. Also the feature is designed to avoid third party systems competing for energy with the starter motor and so maximize energy for crank on the first attempt. For continuous key cycles, the relay will remain open for each 60 seconds period. Function will reset after 60 seconds and can be used again.

Diagnostics

The system will provide diagnostic messages via an LED indicator on the modules enclosure. Certain conditions will be transmitted to the Status Indicator pins to show the normal operation state or fault during operation. This will help identify a failure mode coded by a mark space ratio output, see the System Diagnostic - Operation table.

The system will expect 12V on the 5 MODE pins with various combinations. When a change happens in the MODE bridge pins, the system will detect the change and give necessary response via an LED. The system will check the mode pins every ignition cycle or when a hardwire voltage reset is detected. Checking which mode can therefore be done at every ignition cycle. The system transmits an LED color message when a bridging change is detected on the MODE pins, see System diagnostic – Mode Setup.

If the system detects more than one failure mode, the failures are transmitted to an LED one after the other. When one of the fault condition is cleared (corrected), the next detected failure mode would be transmitted until all faults are cleared. The system will give an LED light colors and flash rates as shown in the System Diagnostic

FPBG Diagnostic - Operation

Function/Signal	Status	LED Color Sequence	Status Indicator Output (Signal Pattern)
12V Ford Battery (Battery Sense & Power)	OK	G	
	Low Voltage	OO	
12V Modifier (Battery Sense)	OK	G	
	Low Voltage	OOO	
	Open Circuit	RRR	**OOO**
Engine Run Alternator Protection	OK	G	
	Low Voltage Cut-Off	RRRR	**OOOO**
Power Isolation Warning	Not Triggered	G	
	Triggered	OOOOO	
External Charger - Engine Off	Not Detected	G	
	> 13.5V Detected	O-O	
	IGN2 Detected	R-R	**O**
Over Voltage Protection (>15.8V)	OK	G	
	Over Voltage	RRO	**O-OO**
Immediate Relay Contact Open	Not Triggered	G	
	Triggered	OO-OO	**OO-OO**
Immediate Relay Contact Close	Not Triggered	G	
	Triggered (Close Switch)	OOO-O	**O** Continuous
Ignition Position 2 (Engine Run)	OK	G	
	Open Circuit	RRR-RR	**OOO-OO**
FPBG Internal Failure	No Failure	G	
	Soft Voltage Reset (Ignition Cycle)	RRR-R	**OOO-O**

G = Green, O = Orange, R = Red, -= Space

FPBG Mode Setup LED Sequence

Mode Condition	Status	LED Color Sequence	Number or Repeat Sequence
Pin Check - Ever Ignition Cycle & Hardware Voltage Reset	Change Detected	G O R	2
Setup Change Issue	Not OK Combination	O R	3
Setup Successful	OK Combination	G O	3
1 Selected	OK	G	1
2 Selected	OK	G G	1
3 Selected	OK	G G G	1
4 Selected	OK	G G G G	1
5 Selected	OK	G G G G G	1
6 Selected	OK	G G G G G G	1
7 Selected	OK	G G G G G G G	1
8 Selected	OK	G G G G G G G G	1

G = Green, O = Orange, R = Red

Further Information:

- Normal functionality at ignition ON or OFF may lead to a clicking sound of the relay opening and closing as part of its strategy. The end operator may need to be advised of this condition
- The main +12V feed supply is taken from the main Ford battery cable. It is not permitted to touch this interface. Further power take off must come from the Ford Customer Connection points as shown in the section Electrical Connectors and Connections
- If the fuse needs to be down-rated, a Mega fuse size can only be used. The fuse value must not exceed 175 Amp
- Emergency isolation for safety applications must not be used by the isolation feature. If control is lost, to the main relay, it remains in the same state as is a latched type relay
- It is recommended that a latched switch on the relay close circuit always be installed. There are certain scenarios related to mains chargers and engine off quiescent voltage that may be above 13.1V, that the relay contacts would need to be closed manually, to deliver power to the third party systems when required
- If the timer value is never or rarely achieved, the following factors maybe the reason:
  - Wrong battery and alternator specification (too small ratings) for the third party load
  - System degradation has occurred, such as failing batteries (always check battery condition, if this keeps occurring contact your local Ford dealer for a battery health check), other systems are fitted draining the batteries (such as trackers or other third party loads, connected to the CCPs)
  - Incorrect installation such as battery sense lines not installed
  - Wrong mode configuration set to required timer value
  - Main mega fuse is open circuit
  - Cold temperatures will lower battery voltage and ability to hold or receive charge
  - Drive cycle versus engine off application is not providing enough time to charge up the batteries
  - Alternator performance issues, saturated or failed
  - Peripherals left always plugged into 12V Power Cigar sockets (which are no longer on 30 minute battery saver but deactivate at 60% Battery SOC)
- When cutting the linked wires to set the mode, it is recommended to insulate each cut wire
- The system at full load must not let the alternator drop below 13.0V. This is an indication that the alternator and system is saturated and cannot meet the demand for power

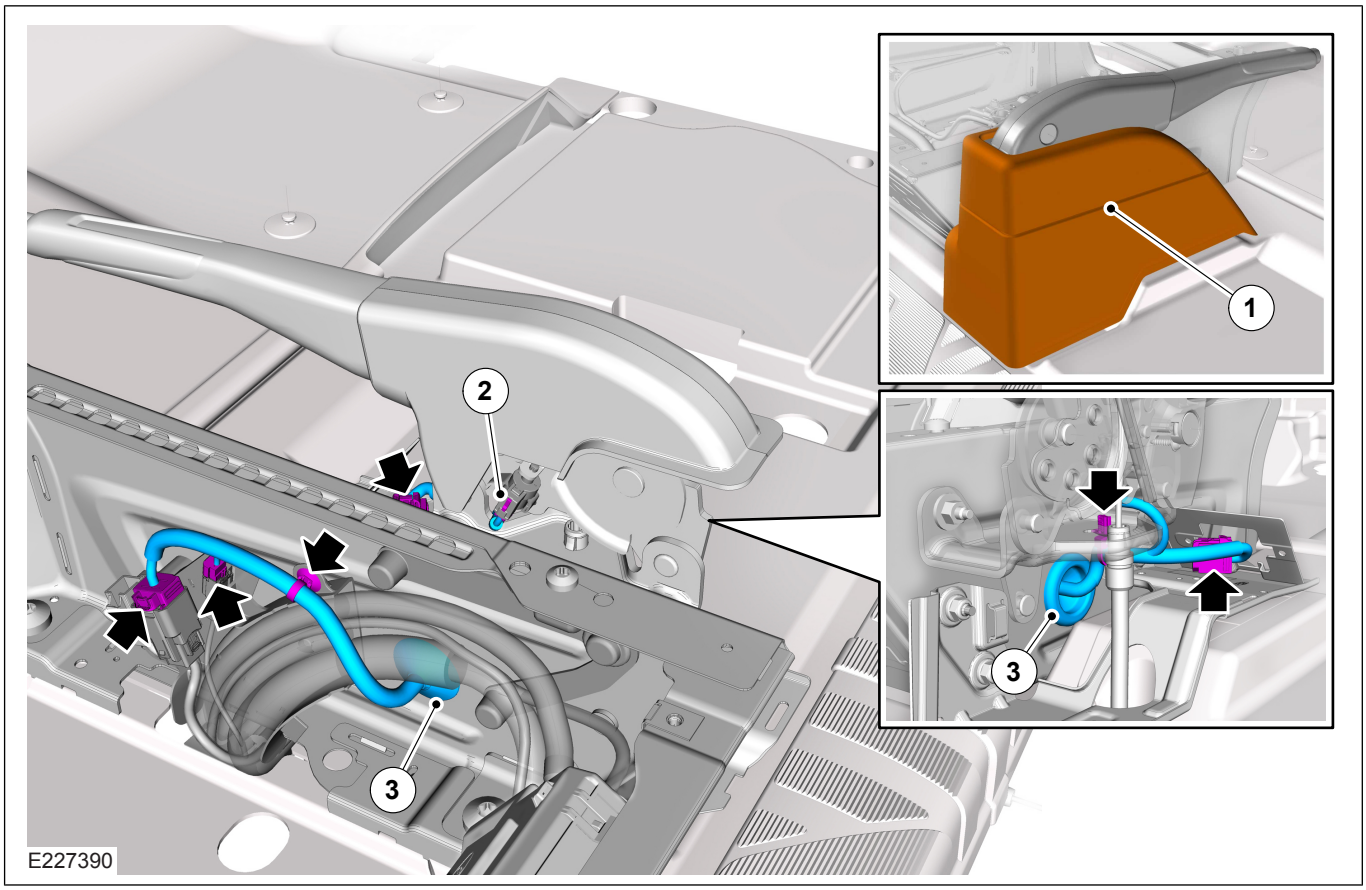
- For static conditions, in workhorse mode for the third party main load, the operator may need to be instructed to manually load shed Convenience Ford systems to maximize available energy from the alternator. Further systems may also help performance such a the Stationary Elevated Idle Control (SEIC) or Battery Charge Protect (BCP)
- Mains chargers must be of the multi stage type (include trickle charge) and be checked for performance before installation as the system will connect all batteries to the charger. For instance, the charger has adequate current limiting to avoid overload
- The output warning features may occur during a normal drive cycle. Therefore audible or visual peripherals, connected to the outputs should be located where not deemed a distraction to the driver. I.e. a buzzer only on the cherry picker external platform and a small LED warning lamp in the CAB area
- The system cannot be ordered as factory fit option or retrofitted with the Ford 150 Watt inverter as it utilizes the same package space. However, this system can power a 2,000 watt third party fit inverter as long as the 175A rating is not exceeded
- The relay may cycle between 8 hour periods, closing the relay when connected to a mains charger at key off load, depending on battery voltage during long engine off periods. This is normal functionality and designed to ensure adequate charge is given to all batteries
- For the 175A ground point, the modifier is to supply their own ground location or utilize the auxiliary ground as shown in battery and cables or ground points section
- Before performing a Mode change or initial setup, the modifier is to un-power the system to avoid risk of contact between Mode Pins (+12V) and the vehicle body. The Mode pins have to be cut according the Mode Table to setup correct Mode for vehicle battery configuration. This could be achieved either by disconnecting the system feed connector, or removing all battery B- terminals completely. Note that removing the system cable from the battery is not enough to disconnect the power from the module. On the Mode Pins setup, none of the cut mode wires should be grounded as damage to the module could occur
- For high current applications above 70A and at engine Run, vehicle load shedding must be applied and battery cables and alternator temperatures must be monitored. For these applications the 240A high power alternator must also be fitted
- If continuous heavy load usage is required the following values and duration must comply to the following:
  - 70A to 90A, a maximum of 10 minutes is allowed
  - 91A to 120A a maximum of 4 minutes is allowed
  - 121A to 175A a maximum of 1 minute is allowed
- It is recommended to disconnect loads for at least 10 minutes for the cool down after the defined duration is achieved. Different system conditions may lead to longer waiting period, for example: wiring cross sectional area, cable length and impedance in the system. It is recommended that the modifier tests the finished system to define cool down period in between the usages
- If the vehicle does not come with the 240A alternator, or longer duration is required at these amperage values above, then a dedicated alternator and power cabling must be applied to avoid saturation to the Ford alternator and any thermal issues on vehicle wiring and related systems
- Under heavy load applications, total system impedance should be calculated to design for volt-drop conditions. Power supply cable should be added as short as possible and to the correct cross sectional area as described in Wiring Specification Table
- General system re-setting function is performed via Ignition cycle. If functionality does not restore, check Status Indicator output message or Diagnostic LED on the module. For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com
- The engine off "Load Active Input" should not be used on loads less than 20A. This is due to the load drop below this value being close to actual SOC of the battery where this is below energy required to crank
- The timers of the battery guard has certain tolerances depending on the assessment factors in the system. There will be slight time variations in reaction time differences for the inputs and outputs as the system does not require calibrated chronometer accuracy

4.4.9 The Ford Programmable Battery Guard System - Aftermarket Fitting

NOTE: If the vehicle is fitted with 150W Inverter this will need to be removed to enable retrofit of the Ford Programmable Battery Guard System. A new Hand Brake Console will be required for less 150W Inverter.

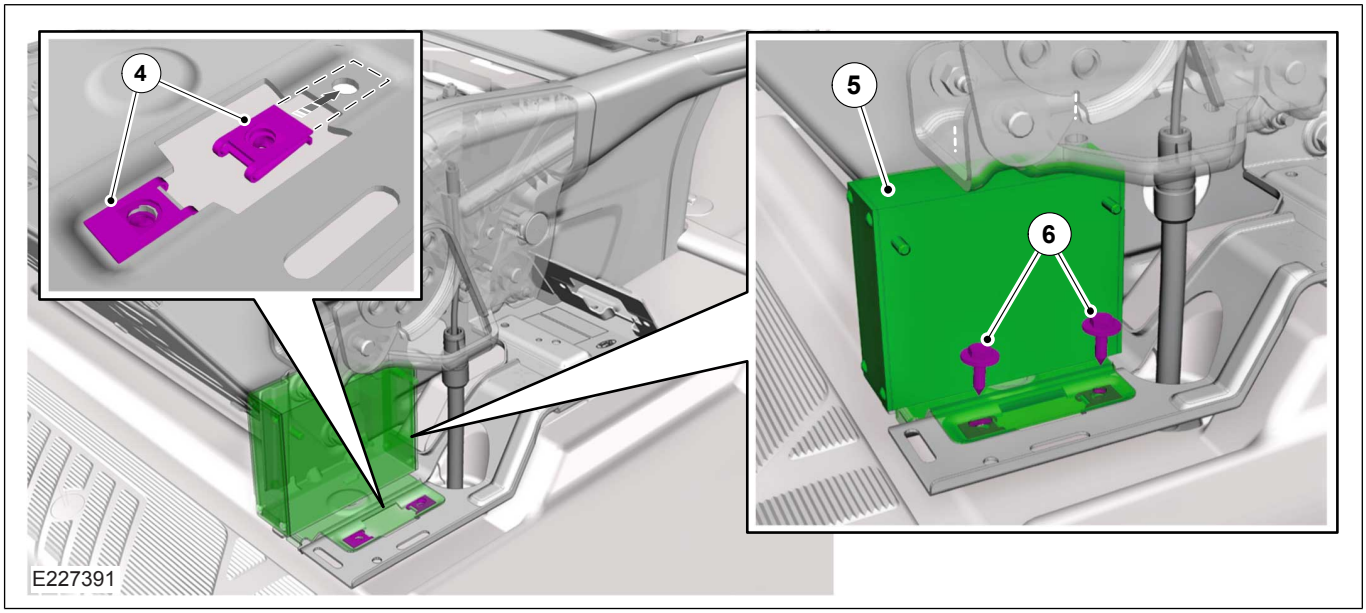
NOTE: It is necessary to remove the upper seat, disconnect the battery/batteries power and take out the battery/batteries (and box if one) prior to fitting the Ford Programmable Battery Guard System. For further information please go to the Body Builders Advisory Service, https://fordbbas.com, or email bbasqa@ford.com

Removal of Handbrake Harness



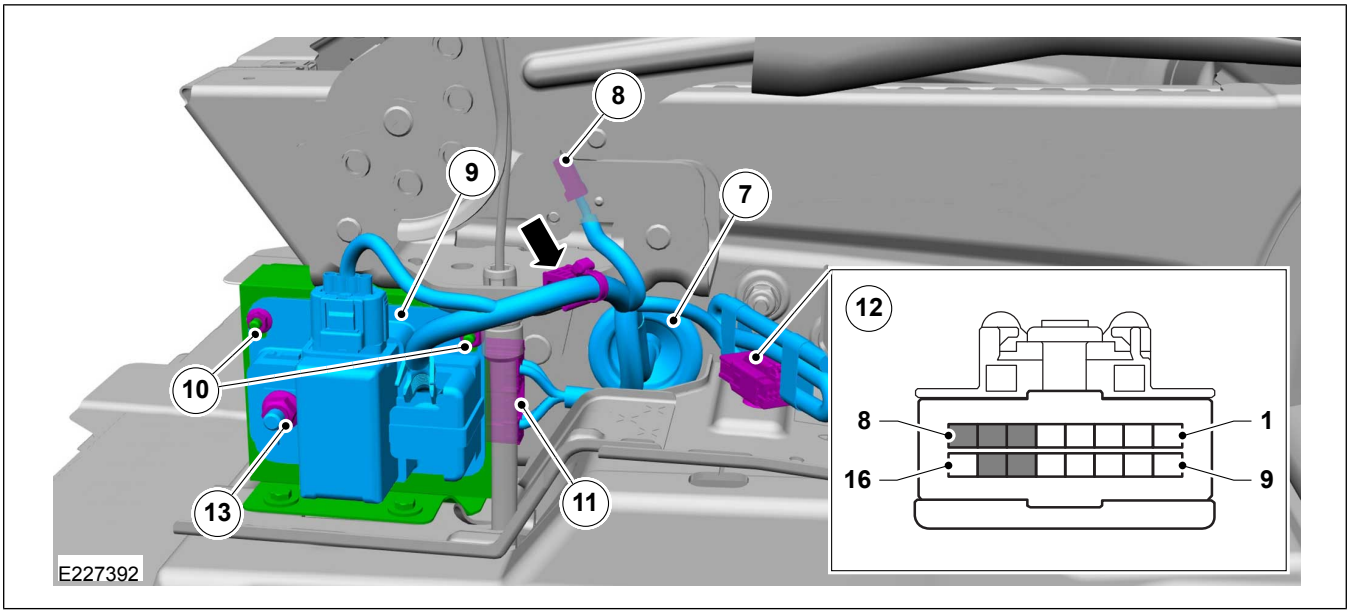
1. Remove Handbrake Console
2. Disconnect the Handbrake Lever Connector
3. Remove Grommet, disconnect Connectors, Firtree Clips, Tiewraps. Dispose of Harness.

Ford Programmable Battery Guard Module



4. Fit 2x U Nuts
5. Fit Module
6. Secure Module with 2x screws - torque 3.2Nm ±0.5Nm

New Harness Routing - Outside Pedestal

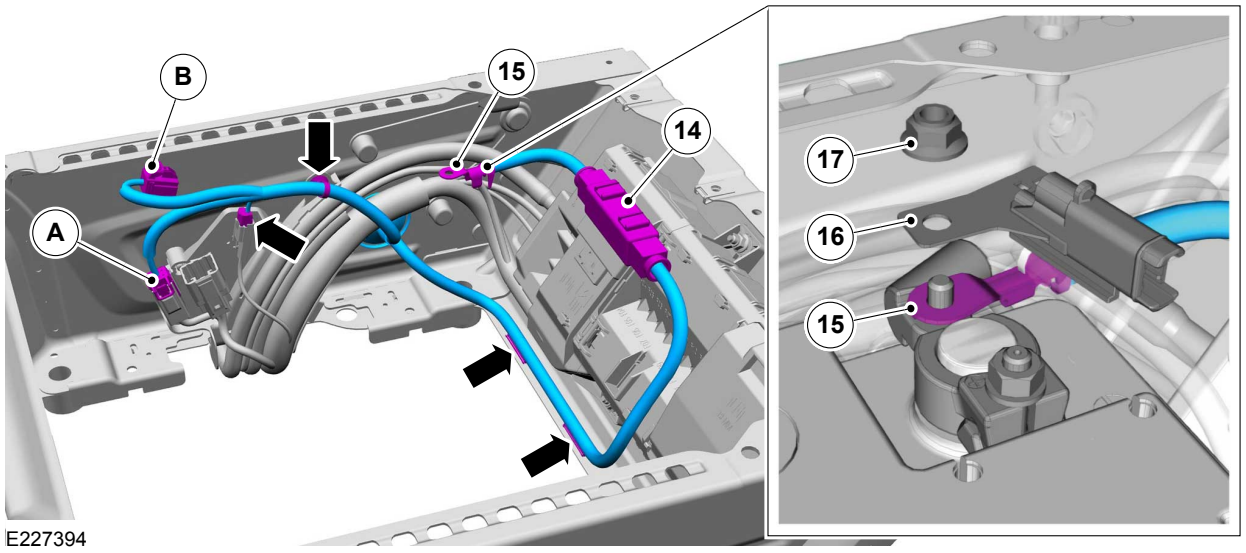


7. Route Harness through the drivers seat pedestal, making sure the grommet is seated/sealed properly making sure the harness does not obstruct or interfere with the handbrake cable and assemble edge clip to handbrake bracket.
8. Fit Handbrake Connector
9. Fit Relay Holder
10. Secure Relay Holder with 2x M5 Nuts - Torque 3.2Nm ±0.5Nm
11. Fit Module Connector
12. FPBG Interface Connector - Mating Connector face view showing Mode Configuration Pins 15,14,8,7 and 6
13. FPBG Power Connection - Relay Terminal Nut - Torque 12Nm ±1.8. See also figure E252619.

FPBG Interface Connector - see item 12 in figure E227392

Pin	Description	Wire Color
1	Close Relay Request Input - SW GND	Yellow/Gray
2	Open Relay Request Input - SW GND	Blue/Red
3	Not used	-
4	B+ Modifier Battery Sense Line	Black/Gray
5	Not used	-
6	Mode Configuration Pin 6	Gray
7	Mode Configuration Pin 7	Green
8	Mode Configuration Pin 8	Blue
9	Load Active Input	Blue/Gray
10	Not used	-
11	Power Isolation Warning	Black/Yellow
12	Status Indicator / Diagnostics	Gray/Orange
13	Not used	-
14	Mode Configuration Pin 14	Red
15	Mode Configuration Pin 15	Black
16	Ignition KL15 +12V	Gray/Yellow

New Harness Routing - Inside Drivers Seat Pedestal

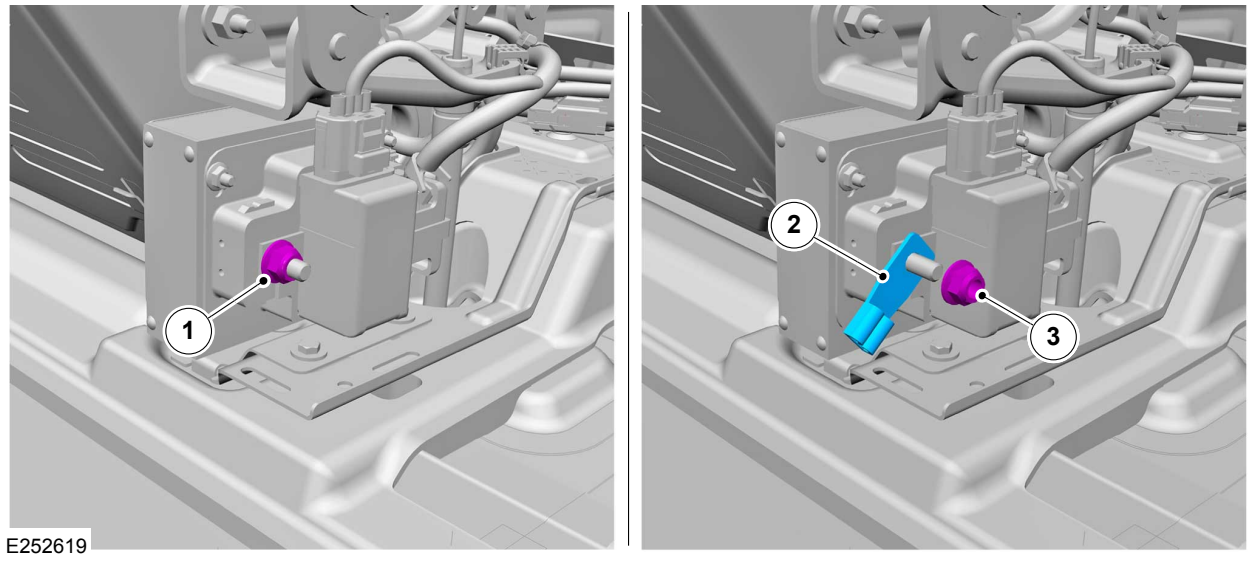


14. 175A Mega Fuse - Route and connect harness as shown in E227394
15. Battery Positive Eyelet (After routing the FPBG System, refit the battery/batteries into the pedestal and reconnect as shown in E227394)
16. Battery Monitoring Sensor
17. M6 Nut - Torque 8.0Nm ±1.2Nm

NOTE: Vehicles without Auxiliary Fuse Panel need to use connector 'A' location, Vehicles with Auxiliary Fuse Panel need to use connector 'B' location.

Use correct torque when re installing the upper seat.

FPBG Power Relay Terminal - Third Party Power Connection (+12V)



1. Remove M8 Nut
2. Place Third Party Power Cable Eyelet onto M8 Stud
3. Secure M8 Nut to Torque 12Nm ±1.8

4.4.10 Single and Twin Battery Systems

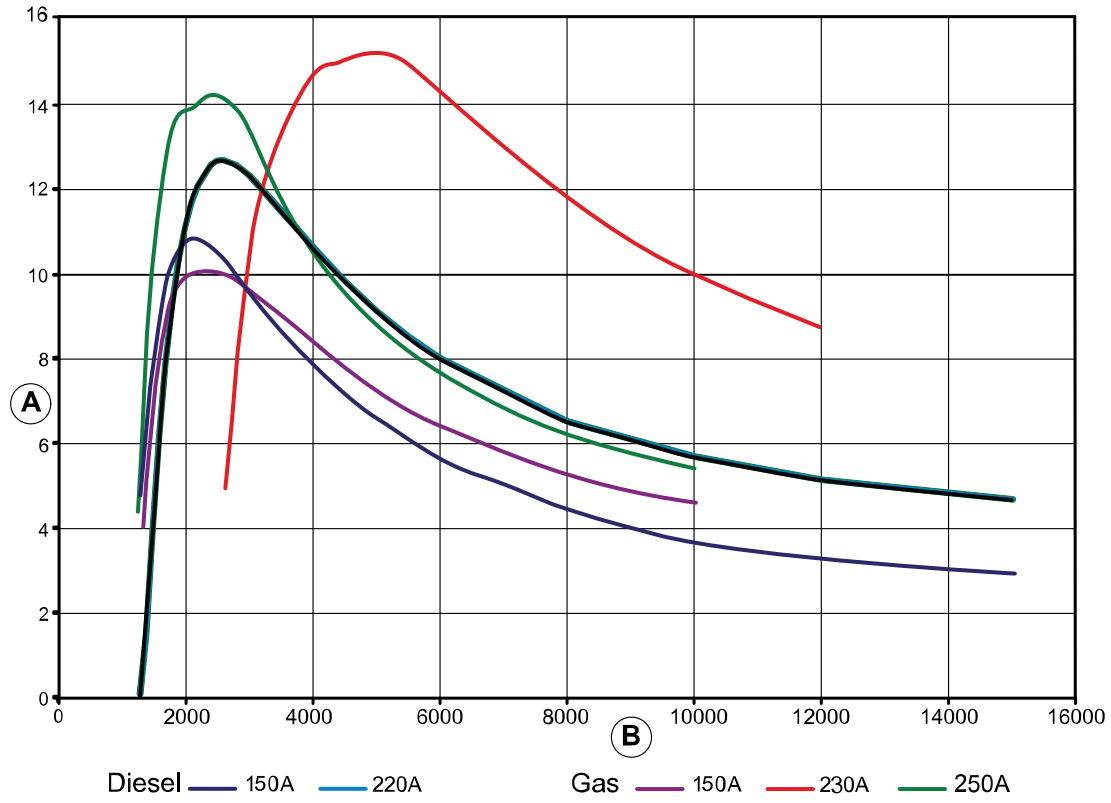
WARNING: It is important that the battery box lid/covers are replaced after any conversions to the battery positive terminal. If te battery lid/cover is missing or damaged, a replacement part must be ordered and fitted. It is recommended to check fitment as part of the quality control process.

Battery Cables and Components

A vehicle ordered with a single battery can be modified to twin batteries.

4.4.11 Generator and Alternator

Torque Curves of Alternators



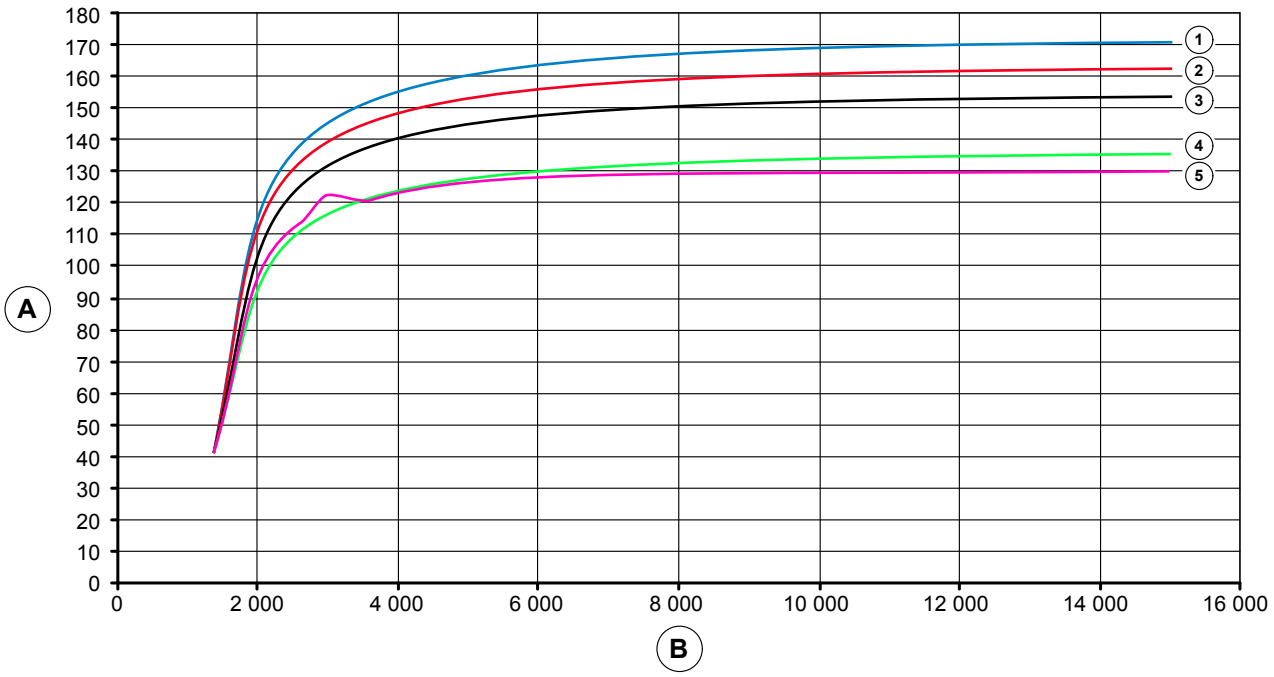
E284685

Diagram E284685 shows the torque in Nm which is required to drive the alternator at full output. The vertical axis (A) shows the torque (Nm) and the horizontal axis (B) shows the alternators revolutions per minute (rpm).

NOTE: For equivalent engine revs per minute (rpm), the alternators revolutions, axis (B) should be divided by the following factor: 2.69 for 3.2L diesel.

NOTE: These alternator curves do not show spare output capacity as this would be dependant on original vehicle features and options.

Output Performance of Alternator - Diesel - 150A Standard



E75873

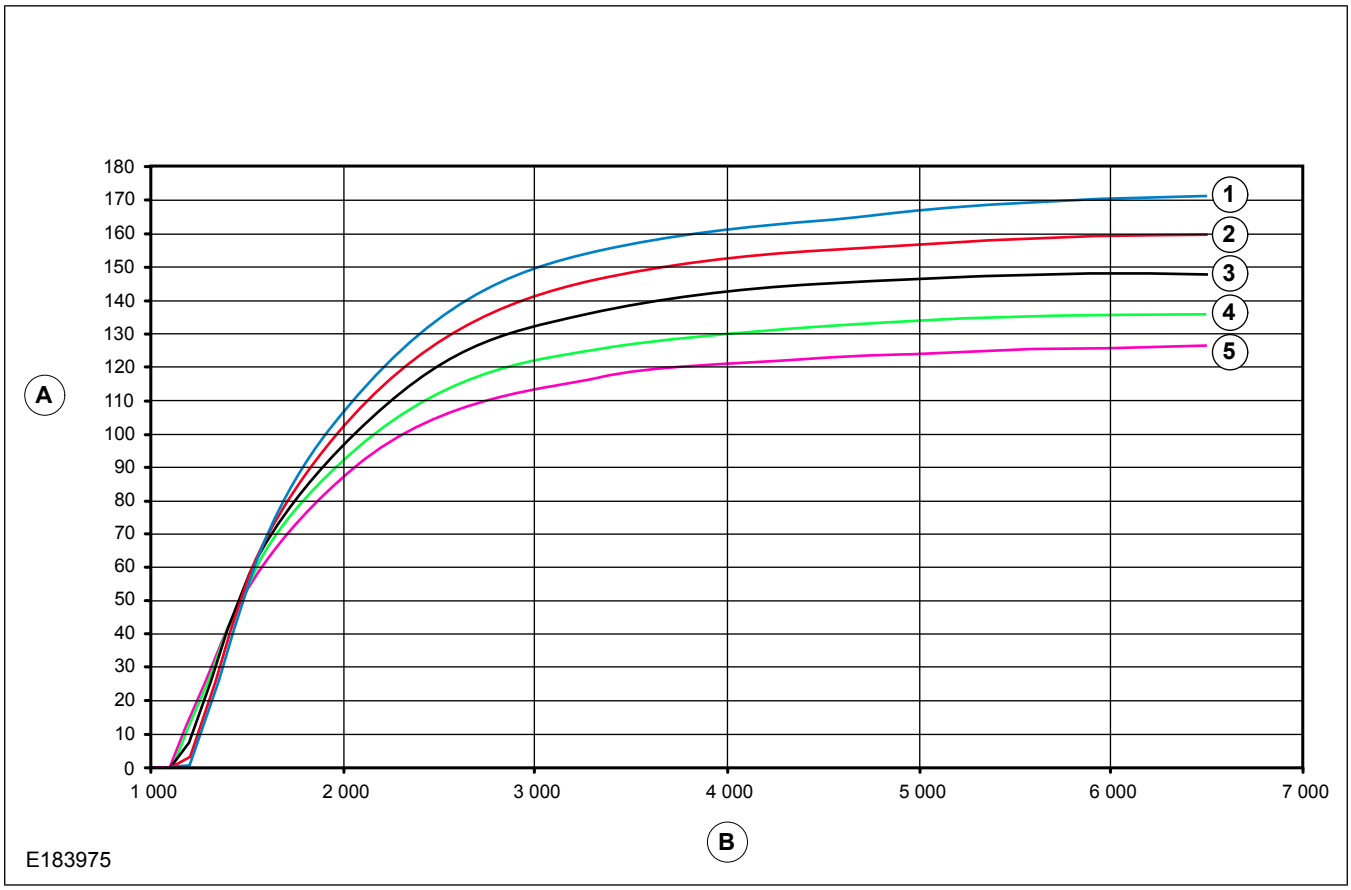
Item	Description
1	Temperature 30°F/0°C — Voltage 14.1V
2	Temperature 80°F/27°C — Voltage 13.8V
3	Temperature 140°F/60°C — Voltage 13.5V
4	Temperature 200°F/93°C — Voltage 13.1V
5	Temperature 240°F/115°C — Voltage 12.9V

Diagram E75873 shows the alternator output performance at five different temperatures In accordance to Ford specification at five different temperatures. The vertical axis (A) shows output current (Amps) and the horizontal axis (B) shows alternator speed in revolutions per minute (rpm).

NOTE: For equivalent engine revs per minute (rpm), the alternators revolutions, axis (B) should be divided by the following factor: 2.7 for Gas Engines.

NOTE: These alternator curves do not show spare output capacity as this would be dependent on original vehicle features and options.

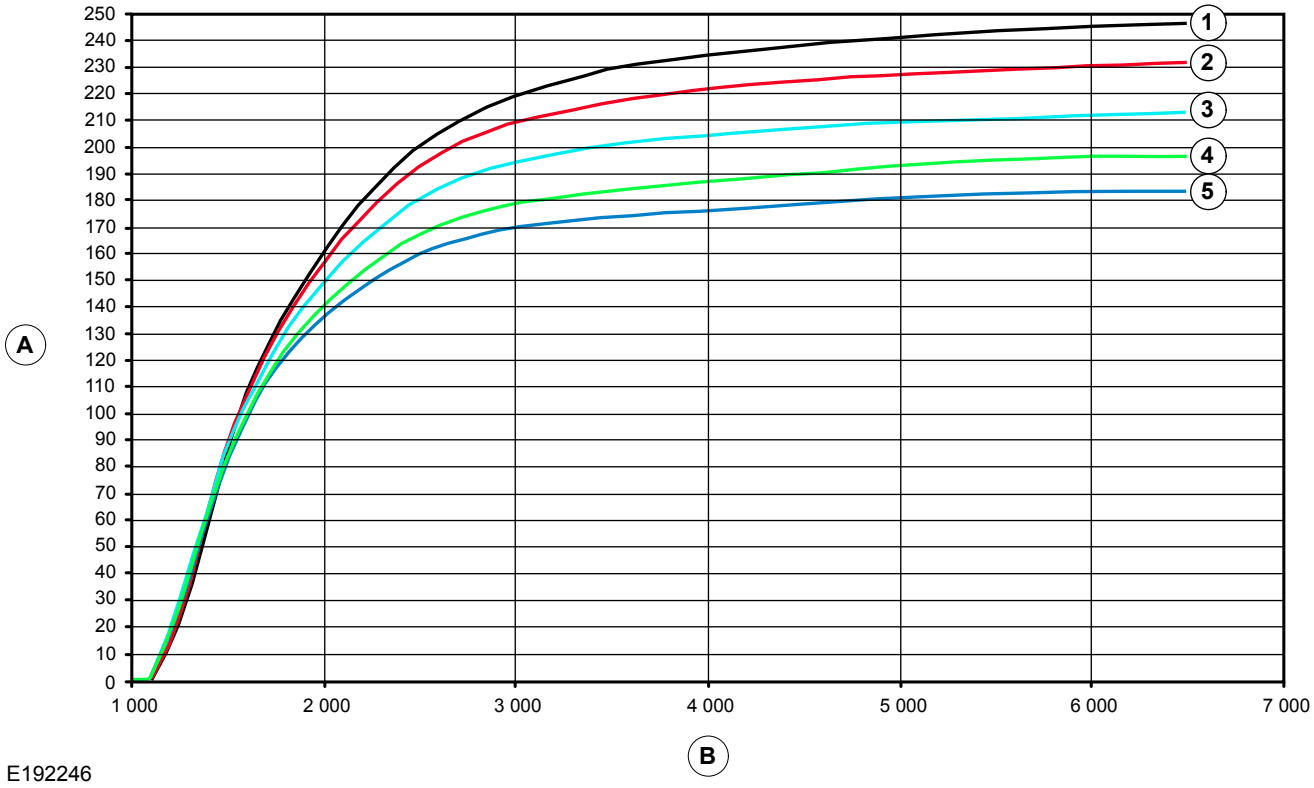
Output Performance of Alternator - Gas - 150A Standard



Item	Description
1	Temperature 30°F/0°C — Voltage 14.1V
2	Temperature 80°F/27°C — Voltage 13.8V
3	Temperature 140°F/60°C — Voltage 13.5V
4	Temperature 200°F/93°C — Voltage 13.1V
5	Temperature 240°F/115°C — Voltage 12.9V

Diagram E183975 shows the alternator output performance at five different temperatures In accordance to Ford specification at five different temperatures. The vertical axis (A) shows output current (Amps) and the horizontal axis (B) shows alternator speed in revolutions per minute (rpm).

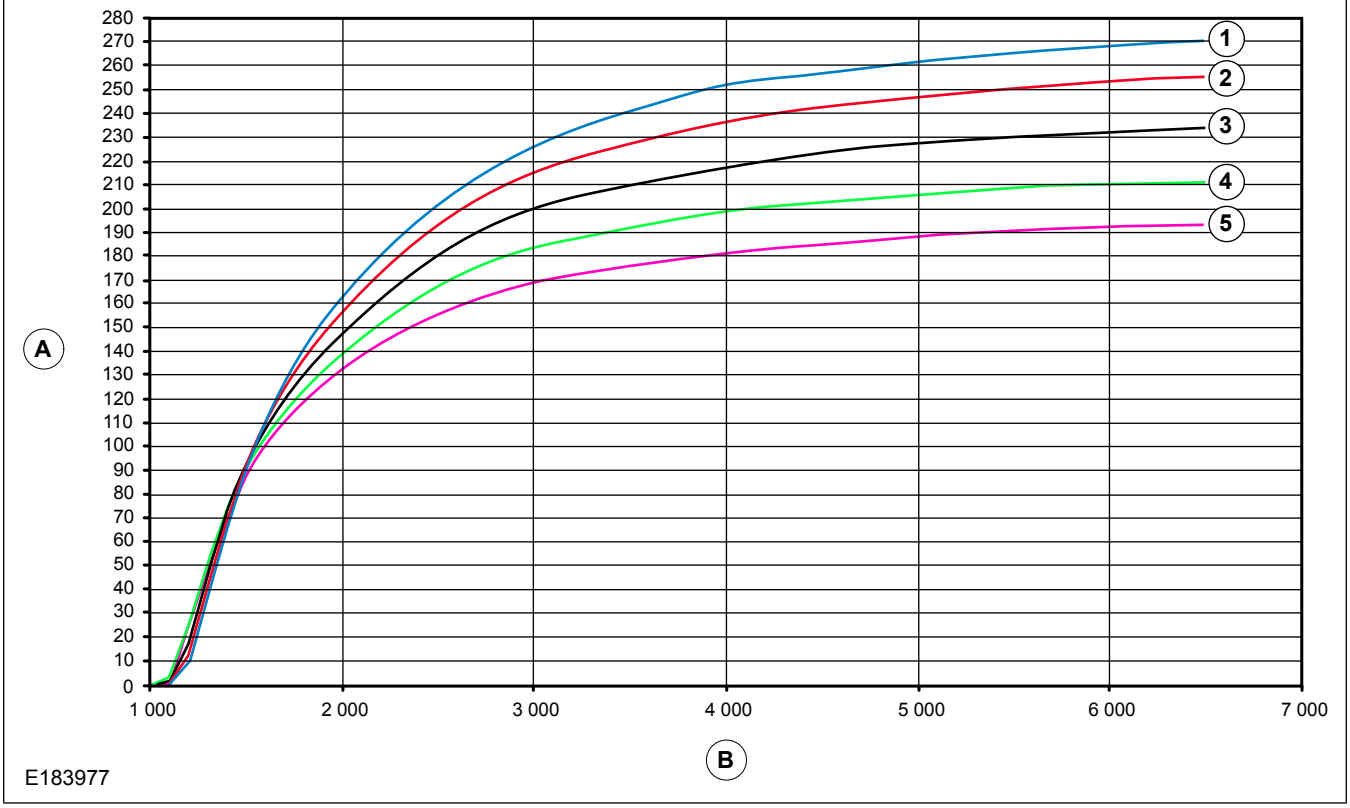
Output Performance of Alternator - Gas - 230A Heavy Duty



Item	Description
1	Temperature 30°F/0°C — Voltage 14.1V
2	Temperature 80°F/27°C — Voltage 13.8V
3	Temperature 140°F/60°C — Voltage 13.5V
4	Temperature 200°F/93°C — Voltage 13.1V
5	Temperature 240°F/115°C — Voltage 12.9V

Diagram E192246 shows the alternator output performance at five different temperatures In accordance to Ford specification at five different temperatures. The vertical axis (A) shows output current (Amps) and the horizontal axis (B) shows Alternator speed in revolutions per minute (rpm).

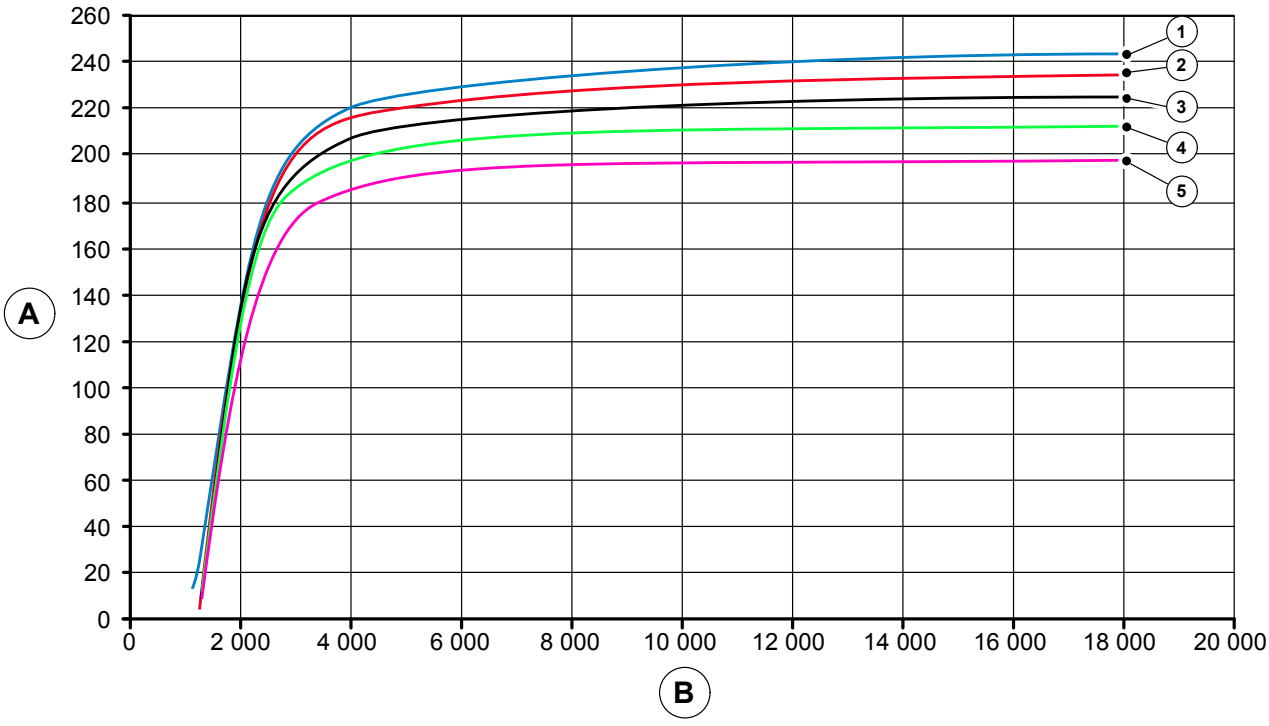
Output Performance of Alternator - Gas - 250A Heavy Duty



Item	Description
1	Temperature 30°F/0°C — Voltage 14.1V
2	Temperature 80°F/27°C — Voltage 13.8V
3	Temperature 140°F/60°C — Voltage 13.5V
4	Temperature 200°F/93°C — Voltage 13.1V
5	Temperature 240°F/115°C — Voltage 12.9V

Diagram E183977 shows the alternator output performance at five different temperatures In accordance to Ford specification at five different temperatures. The vertical axis (A) shows output current (Amps) and the horizontal axis (B) shows alternator speed in revolutions per minute (rpm).

Output Performance of Alternator - Diesel - 210A Heavy Duty



E146660

Item	Description
1	Temperature 30°F/0°C — Voltage 14.1V
2	Temperature 80°F/27°C — Voltage 13.8V
3	Temperature 140°F/60°C — Voltage 13.5V
4	Temperature 200°F/93°C — Voltage 13.1V
5	Temperature 240°F/115°C — Voltage 12.9V

Diagram E146660 shows the alternator output performance at five different temperatures In accordance to Ford specification at five different temperatures. The vertical axis (A) shows output current (Amps) and the horizontal axis (B) shows alternator speed in revolutions per minute (rpm).

4.5 Climate Control System

WARNING: Do not use propylene glycol based coolant.

- Never secure hoses or tubes to the transmission fill or dip stick or to any fuel system or brake component.
- Do not route heater or refrigerant lines near or directly over any exhaust system component, including the exhaust manifolds.
- Avoid routing of hoses in the wheelhouse or stone kick-up arch. If routing is required in these areas, shield against stone pecking as appropriate.
- Do not route hoses near sharp edges. Utilize guards to protect against cutting or chafing.

4.6 Instrument Panel Cluster (IPC)

WARNING: Do not tamper with, cut into or connect to any of the CAN-Bus interface wiring or connectors.

Most of the functions are managed over the CAN-Bus interface.

Instrument Cluster

Connector Pin (C1)	Description	Wire Color	
1	MS CAN -	Violet/Orange	Twisted
2	MS CAN +	Gray/Orange	
3	Power	Red	-
4	MS CAN Low	Violet/Gray	Twisted
5	MS CAN High	Blue/Gray	
6	Cluster Signal Ground	White/Brown	-
7	Cluster Signal	Yellow	-
8	Cluster Set	Green/Violet	-
9	Automatic Transmission	-	-
10	Ground	Black/Violet	-
11	Tachograph	Gray/Blue	-
12	Crank Detect	White/Green	-

4.7 Horn

A dual horn may be fitted to the vehicle in place of the single horn.

Any other aftermarket horn (for example an air horn) will need to be driven by a separate relay energised by the horn circuit.

4.8 Electronic Engine Controls

CAUTION: Do not make any additional connections to the electrical circuits associated with the engine management system.

NOTE: It is not necessary to disconnect or remove engine management modules.

4.8.1 DPF & RPM Speed Control

The Diesel Particulate Filter (DPF) captures soot in the exhaust fumes to improve vehicle exhaust emissions. The condition of the DPF is monitored by the vehicles electronic systems. Under normal driving conditions a regeneration feature is triggered to burn off the build-up of soot, replenishing the filter. If the DPF becomes full, a red engine warning lamp illuminates on the instrument cluster and the vehicle will need to be taken into the local Ford dealer to have the DPF specially purged.

4.9 Tachograph

It is recommended that any vehicle that requires a tachograph is sent to an authorised Continental Tachograph Service Center (previously known as Siemens VDO) for system installation and calibration.

NOTE:

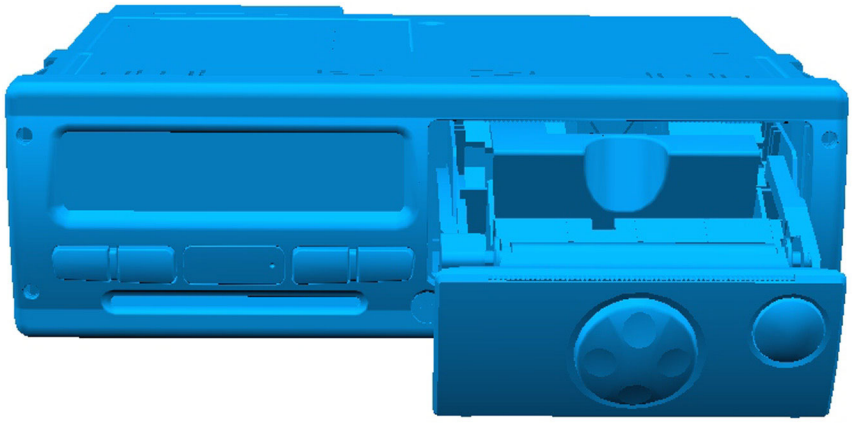
Details of all recommended service centers can be found on VDO web sites. These sites also contain details of current regulations and tachograph operation.

4.9.1 Legislation

WARNING: All tachographs require the same wiring connections as this is controlled by tachograph legislation.

NOTE: Digital Tachograph (DTCO) is the legal requirement for Europe.

Digital (DTCO) Tachograph



E75502

Pin Assignment

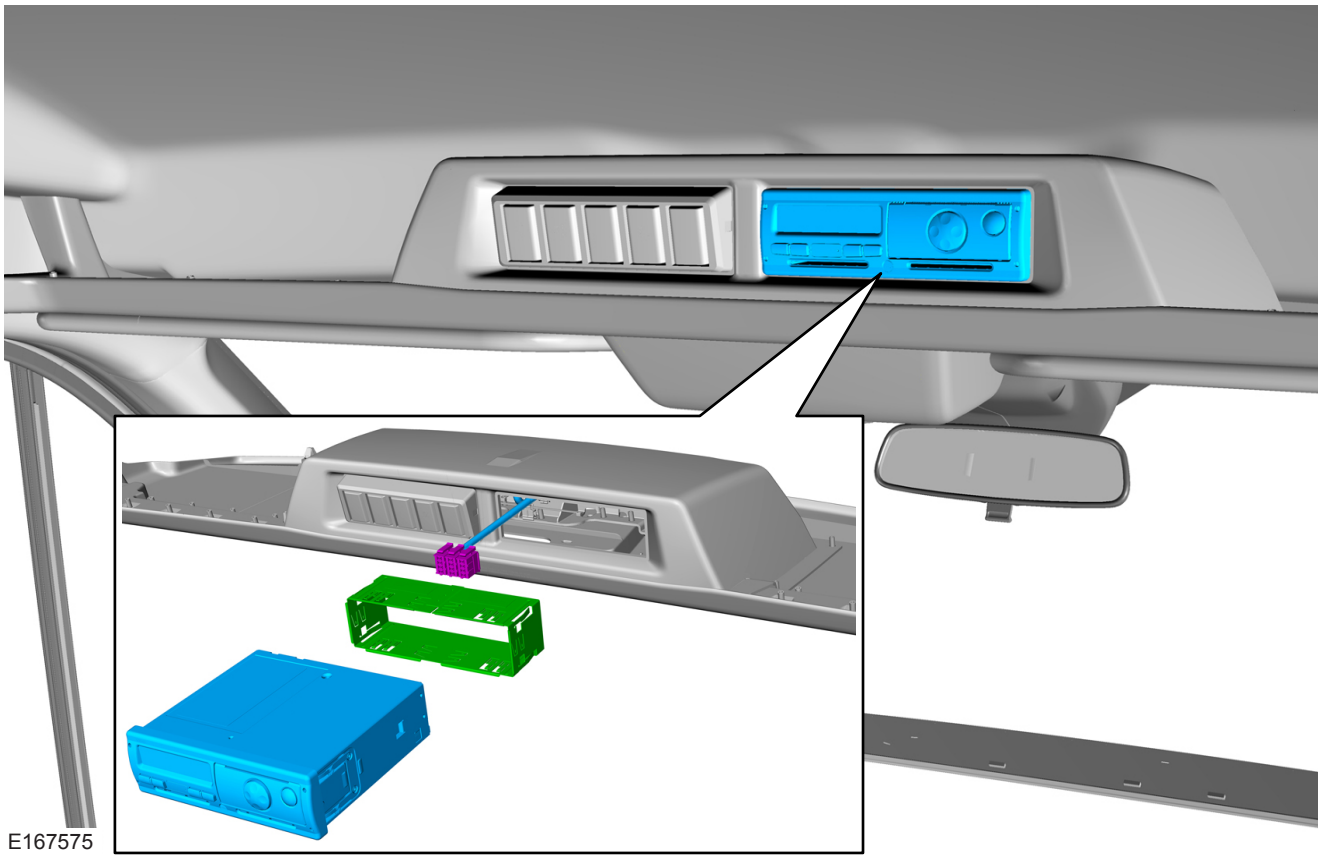
For detailed information about pin assignments please contact your local Ford dealer or Continental Automotive Group directly.

Wiring

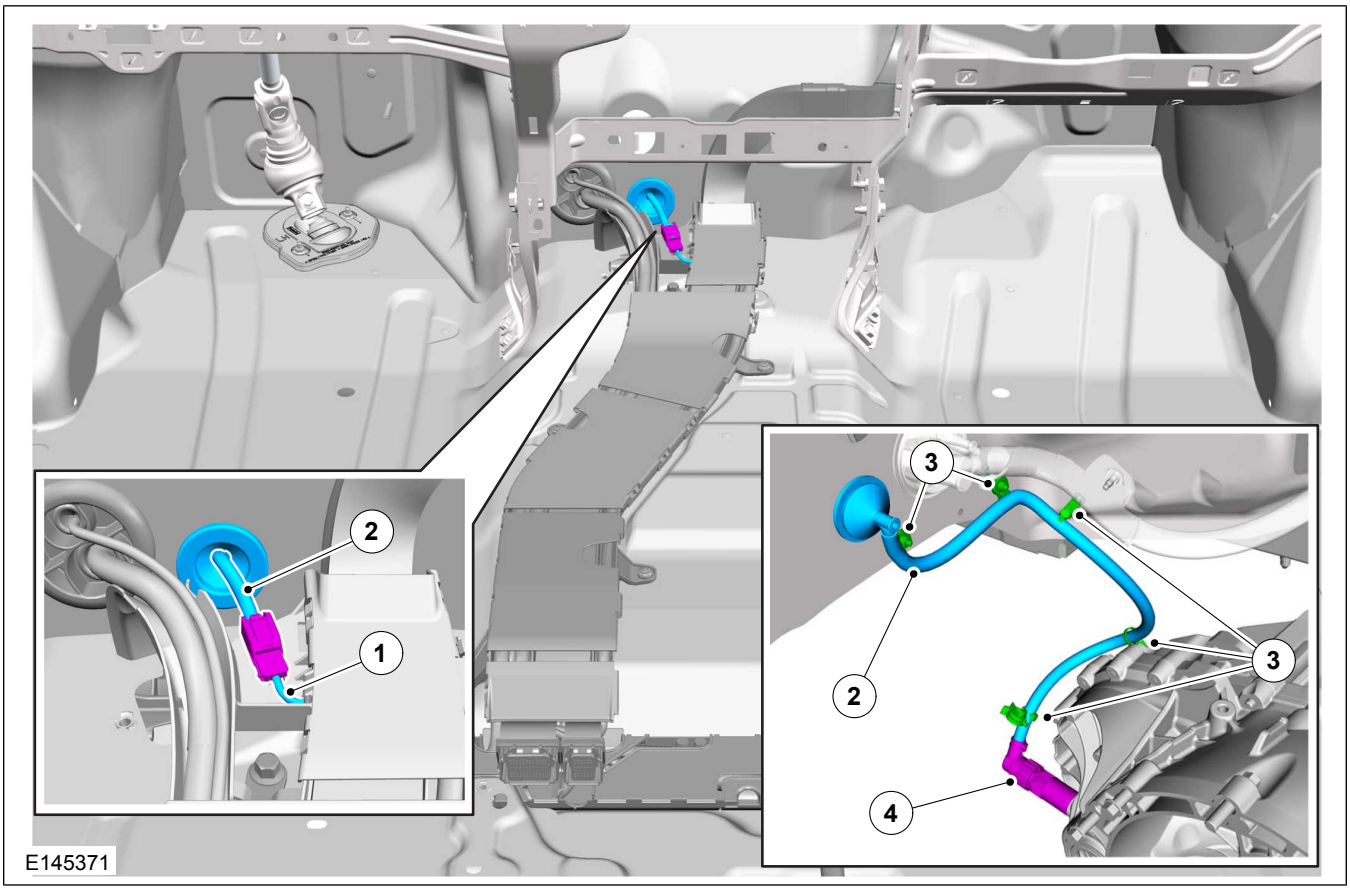
The tachograph wiring consists of two parts:

- Speed Sensor Harness, see figure E225083 and E145371 for harness routing
- Tachograph Harness, see figures E145371 and E167575 for mounting and harness routing

4.9.2 Tachograph Harness Mounting

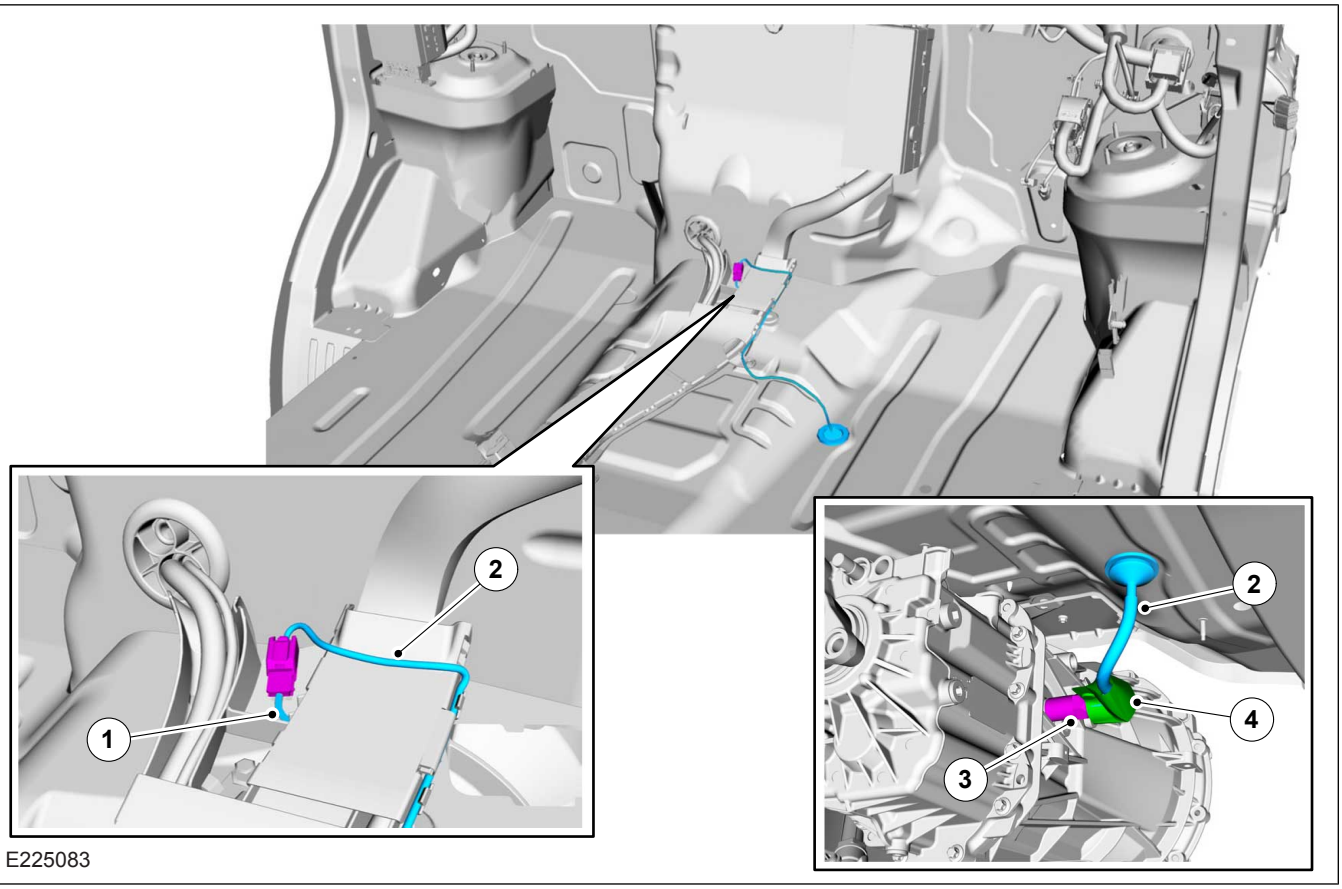


Tachograph Speed Sensor Harness Routing - FWD



Item	Description
1	Main Harness
2	Tachograph Speed Sensor Harness
3	Clips
4	Sensor into Transmission

Tachograph Speed Sensor Harness Routing - RWD



E225083

Item	Description
1	Main Harness
2	Tachograph Speed Sensor Harness through floor
3	Sensor into Transmission
4	Heat Shield

4.9.3 Fitting a Tachograph to vehicles built with out Digital Tachograph Option

NOTE: It is not always possible to retrofit a tachograph. If a tachograph is required, it is recommended that this is ordered on the base vehicle. For further information please go to the Body Builders Advisory Service, https://fordbbas.com/truckbbas, or email bbasqa@ford.com

NOTE: The base vehicle ordered must have an overhead console and the correct level of trim (head liner) to support fitting a Tachograph.

NOTE: The Tachograph units are not supplied by Ford service and are only available by the Continental/VDO Calibration Center. Formerly known as Siemens/VDO.

Parts required to support aftermarket fitting of a Digital Tachograph

Prefix	Base	Suffix	Name
Tachograph Units			
BK2T	17A266	A*	Digital
Speed Sensor			
BK2T	17K321	A*	VMT6 - Front Wheel Drive
BK3T	17k321	A*	MT82 - Rear Wheel Drive
Wiring Harness			
GK2T	14K141	B*	Speed Sensor Harness - Front Wheel Drive
GK3T	14K141	H*	Speed Sensor Harness - Rear Wheel Drive
GK3T	14K141	J*	Roof Tachograph Harness - Front and Rear Wheel Drive

Fitting the Speed Sensor — See figure E167576

1. Locate the sensor housing
2. Remove the protective cap
3. Fit the speed sensor
4. Fit the supporting wiring harness

Fitting the Tachograph Unit — See figure E167575

NOTE: The Tachograph head unit will be fitted by the Continental Calibration Center.

For further information on fitting instructions of a Tachograph unit please email bbas@ford.com

4.9.4 Vehicle Configuration Change

For the cluster to obtain the vehicle speed from the Tachograph the central car configuration parameter 118 needs to be changed to 0x03 – this will be done at the Dealer.

118 Tachograph			
Less Tachograph	HDKAA	0x01	Block 17 byte 7 - Parameter 118
Digital Tachograph	HDKAD	0x03	Block 17 byte 7 - Parameter 118

4.9.5 Calibration and Tachograph Fitting

The Continental Calibration Center will order the Tachograph and fit the unit to the vehicle. EU Legal legislation requires that before the vehicle can be used on the road, the DTCO Tachograph must be calibrated. The Digital Tachograph activation **must** be completed by an authorized VDO workshop. The Ford Dealer will organize the Tachograph Calibration.

When the Tachograph is in an un-calibrated state the vehicle speed indicator in the cluster may not function or may indicate the incorrect vehicle speed. The cluster within the vehicle will use the speed signal from the Tachograph to drive the speed gauge and an un-calibrated Tachograph will not report the correct vehicle speed.

4.10 Information and Entertainment System

4.10.1 Audio Head Unit (AHU) - Multimedia In Car Entertainment (ICE) Pack Summary

The Multimedia System you have, as a standard fit, will depend on the market region, body style and model of the vehicle.

NOTE: Depending on the vehicle upgrade you are planning it is important to order the right level parts that include new Instrument Panel Harness, Instrument Panel Bezel and Hood.

NOTE: Pre Equipment Pack does not have wiring between the roof-mounted AM/FM antenna and the co-axial cable that connects to the AHU. If planning to retrofit an AHU you will need to order the Pre Equipment Pack.

AHU/Multimedia ICE Packs

AHU/ICE Pack	Description
17	Pre Equipment Pack - no audio
18	Connected Radio
19	Low Radio without SYNC
20	Low Radio with SDARS/HD without SYNC
21	Mid Radio with SYNC Gen 1
22	Mid Radio with SDARS/HD/SYNC Gen 1
28	Navigation with SDARS/HDDM6/SYNC Gen 2[(1)]

[(1)]2015 onwards

AHU/Multimedia ICE Pack Content

Description	17	18	19	20	21	22	28
Less ICE	X	-	-	-	-	-	-
Connected Radio AHU/AM/FM	-	X	-	-	-	-	-
ICE - Low Audio (LOC)	-	-	X	-	X	-	-
ICE - Low Audio (LOC) with SDARS/HD	-	-	-	X	-	X	X
Less Multi Function Display (MFD)	X	X	-	-	-	-	-
MFD4 (4.2" Color Screen)	-	-	X	X	X	X	-
DM6 (6" Touch Screen)	-	-	-	-	-	-	X
Less Integrated Control Panel (ICP)	X	X	-	-	-	-	-
ICP Mid - Extended	-	-	-	-	X	-	-
ICP Mid - Extended with SDARS Label	-	-	-	-	-	X	-
ICP Mid - Extended (without SYNC)	-	-	X	-	-	-	-
ICP Mid - Extended (without SYNC) with SDARS Label	-	-	-	X	-	-	-
Mini EFP NAV with SYNC Gen 2	-	-	-	-	-	-	X
2 Front Speakers	X	-	-	-	-	-	-
4 Front Speakers (2 woofer/2 Tweeters) + 2 Rear Speakers [1]	-	X	X	X	X	X	X
Single AM/FM Antenna	X	X	X	-	X	-	-
Single AM/FM + SDARS	-	-	-	X	-	X	X
Less Antenna	-	-	-	-	-	-	-
Less GPSM	X	X	X	X	-	-	-
GPSM	-	-	-	-	X	X	X
Less NAV Data	X	X	X	X	X	-	-
NAV Map Data	-	-	-	-	-	-	X
Less Radio Controls	X	-	-	-	-	-	-
Radio Controls on Steering Wheel	-	X	X	X	X	X	X
Less SYNC	X	X	X	X	-	-	-
SYNC Gen 1	-	-	-	-	X	X	-
SYNC Gen 2	-	-	-	-	-	-	X
Less Microphone	X	-	-	-	-	-	-
Microphone	-	-	-	-	X	X	X
Aux Input Jack (AIJ)	-	X	X	X	X	X	-
Media Hub 1 x USB	-	-	-	-	X	X	-
Media Hub 2 x USB, 1 x SD Card, RCA Connections	-	-	-	-	-	-	X

[1] Rear Speakers are dependent on body style.

4.10.2 Connected Radio

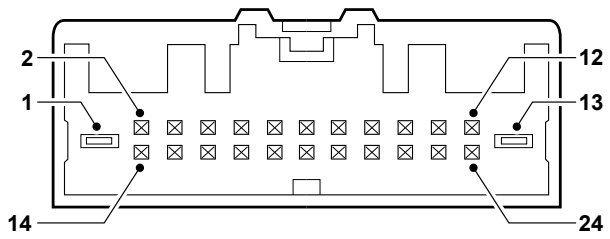
Audio Head Units (AHU) are connected to the instrument panel wiring via a single 24 pin connector, see figure E145370 and table.

NOTE: There is a black co-axial cable for the fender-mounted AM/FM antenna that goes to the side of the AHU.

NOTE: Connected Radio variants do not accept Multi Function Display (MFD) or Integrated Control Panel (ICP)

NOTE: Power for radio - **do not** switch the permanent battery feed (KL 15) and ignition feed (KL 30) on the radio connection.

24 Pin Connector ICE (8475-1 / 544127-1)



E145370

24 Pin Connector ICE

Pin	Description	Type	Pin	Description	Type
1	Battery	Input	13	Audio Ground	Input
2	Switched B+ Power	Output	14	Illumination + (PWM VIH)	Input/ Output
3	Starter Motor Control Sense	Input	17	AIJ Left +	Input
4	Run/Accessory	Input	16	Audio Shield (AIJ)	Output
5	Ignition SW Crank Position	Input	15	Illumination -	Input/ Output
6	Aux IN Jack (AIJ) Common	Input	18	AIJ Right +	Input
7^	Microphone +	Input	19^	Microphone -	Input
8	Steering Wheel Control +	Input	20	Steering Wheel Control -	Input
9	Left Rear Speaker -	Output	21	Left Rear Speaker+	Output
10	Left Front Speaker -	Output	22	Left Front Speaker +	Output
11	Right Front Speaker -	Output	23	Right Front Speaker +	Output
12	Right Rear Speaker -	Output	24	Right Rear Speaker +	Output

^ Pins 7 and 19 are for external microphone. Check availability with your Local Ford Dealer.

4.10.3 Mid-Radio and Mid-Radio with SDARS

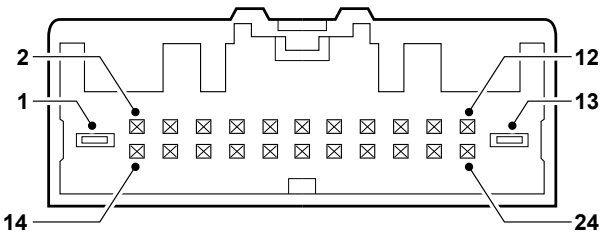
NOTE: AHU/ICE Pack 4,5 and 11 are connected to the instrument panel wiring via a 24 and 26 way connector, see figures E145370 and E146212.

NOTE: There is a black co-axial cable that connects the roof-mounted AM/FM/SDARS antenna to the back of the AHU. If the vehicle has a navigation display, the black co-axial cable goes into the back of the navigation display and a second co-axial cable connects the navigation display to the AHU. There is also a thin black co-axial cable for the global positioning system antenna that goes to the navigation display.

NOTE: All vehicles, except those ordered with a Pre Equipment Pack or Pre Equipment Pack (less speakers) have 2 variants of a Multi Function Display (MFD) and Integrated Control Panel (ICP).

NOTE: Power for radio - **do not** switch the permanent battery feed (KL 15) and ignition feed (KL 30) on the radio connection.

24 Pin Connector (8475-1 / 544127-1)

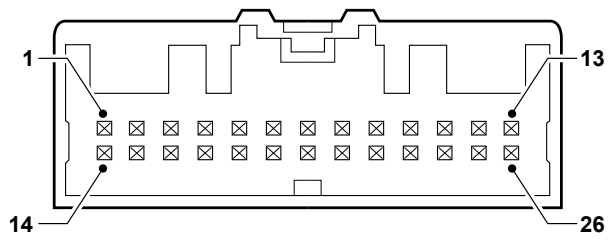


E145370

24 Pin Connector

Pin	Description	Type	Pin	Description	Type
1	Battery	Input	13	Ground	Input
2	Switched B+ Power	Output	14	CAN - High	Input/ Output
3	Not used	-	15	CAN - Low	Input/ Output
4	Navigation Audio In +	Input	16	Audio Shield for AIJ	Output
5	Navigation Audio In -	Input	17	AIJ Left +	Input
6	Auxiliary Input Jack (AIJ) - common	Input	18	AIJ Right +	Input
7	Not used	-	19	Audio Shield for Aux2	Output
8	Not used	-	20	Not used	-
9	Left Rear Speaker -	Output	21	Left Rear Speaker+	Output
10	Left Front Speaker -	Output	22	Left Front Speaker +	Output
11	Right Front Speaker -	Output	23	Right Front Speaker +	Output
12	Right Rear Speaker -	Output	24	Right Rear Speaker +	Output

26 Pin Connector (8476-1 / 544128-1)

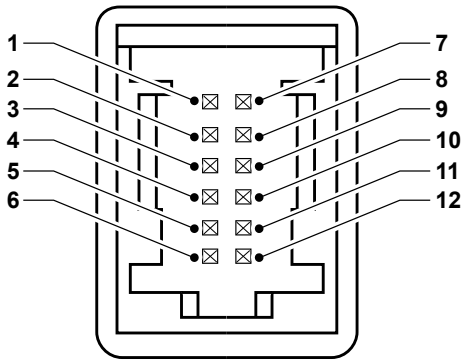


E147212

26 Pin Connector

Pin	Description	Type	Pin	Description	Type
1	Not used	-	14	Not used	-
2	Not used	-	15	Not used	-
3	Not used	-	16	Audio Shield Aux 1	Output
4	Auxiliary Out 1 +	Output	17	Auxiliary Out 1 -	Output
5	Not used	-	18	AE_CD 1	Input/Output
6	Not used	-	19	Not used	-
7	Not used	-	20	Not used	-
8	Alert In +		21	Alert In -	Input
9	Not used	-	22	Not used	-
10	Not used	-	23	Not used	-
11	Not used	-	24	Not used	-
12	Stereo In 1 Left +	Input	25	Stereo In 1 Left -	Input
13	Stereo In 1 Right +	Input	26	Stereo In 1 Right -	Input

Multi Function Display (MFD) 12 Pin Connector

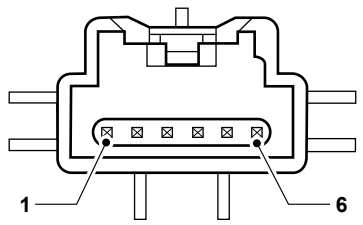


E147213

12 Pin MFD Connector

Pin	Description	Type	Pin	Description	Type
1	Battery	Input	7	Stalk Switch	-
2	Not Used	-	8	MFD — LIN Bus	Input/ Output
3	Not Used	-	9	Ground	Input/ Output
4	CAN — High	Input/ Output	10	Stalk Switch Return/Alarm Sense	-
5	CAN — Low	Input/ Output	11	Ground	Input/ Output
6	RVC+	Output	12	RVC-	Output

Integrated Control Panel (ICP) 6 Pin Connector



E167585

Item	Description
1	Battery +
2	PADI Voltage Ignition
3	PADI ON
4	PADI OFF
5	LIN
6	Ground

4.10.4 Additional Rear Speakers

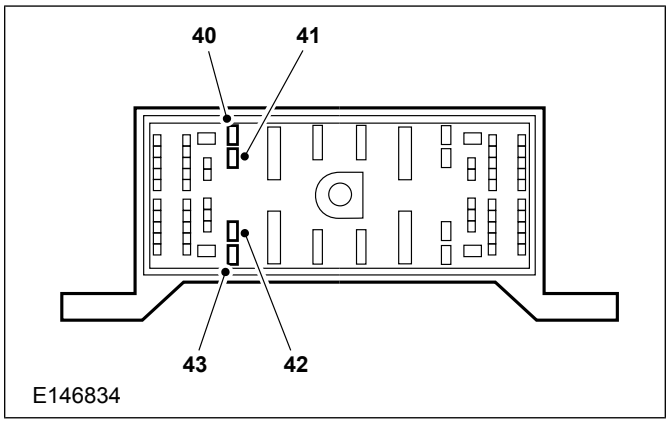
Rear Speakers - Spliced into the Audio Jumper Harness 14C007

Pin	Speaker	Wire Color
24	Right Rear +	Brown/White
12	Right Rear -	Brown/Blue
21	Left Rear +	White/Green
9	Left Rear -	Brown/Yellow

Rear speaker wiring is always present in the instrument panel harness 14K024, but not necessarily in the harnesses 14401 and 13A409/14A333 that then take the signals to the rear speaker locations.

When the rear speakers are not present at the body harness 14401/IP harness 14K024 in-line connector on low series variants the rear speakers may be spliced into the Audio Jumper Harness 14C007 at the rear of the Audio Head Unit, see next table for details.

Rear Speakers - In-line connector 14401/14K024



Item	Description
Pin 40	Rear Speaker Left + (White/Green)
Pin 41	Rear Speaker Left - (Brown/Yellow)
Pin 42	Rear Speaker Right - (Brown/Blue)
Pin 43	Rear Speaker Right + (Brown/White)

4.11 Cellular Phone

WARNING: Installation of any non-Ford-approved system is not recommended and operation with associated systems cannot be guaranteed. Any resultant damage will not be covered under warranty.

Ford offer hands-free and wireless technology (Bluetooth) phone systems (including voice recognition) as factory-fit options, these will also be available as aftermarket accessory kits from your Ford dealership.

These use the Ford MS CAN multimedia bus to operate in conjunction with the Ford audio and navigation systems.

4.12 Exterior Lighting

WARNING: Make sure that the modified vehicle complies with all relevant legal requirements.

4.12.1 Reversing Lamps

Reversing lamps are activated when transmission is in reverse.

The load on the reversing lamps should not exceed a total of 54W.

The reverse tail lamp cicuits are unable to support any additional load. Equipment that requires a reverse signal should use the reverse trailer tow. For more information

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).

Trailer Tow Connectivity.

4.12.2 Additional External Lamps

All power for additional exterior lamps must be taken through the Auxiliary Fuse Panel with a suitable switch and/or relay as required.

Refer to: 4.16 Fuses and Relays (page 124).
Refer to: 4.18 Electrical Connectors and Connections (page 128).
Refer to: 4.17 Special Conversions (page 126).

Lighting Loads

BCM Outputs	Controlling Device	Max. Load	Vehicle
Licence Plate and Marker lamps Supply[1]	High Side Driver	35W	2 x 5W[2]
Position/Parking Lamp Left (Front and Rear)	High Side Driver	23W	2 x 5W
Position/Parking Lamp Right (Front and Rear)	High Side Driver	23W	2 x 5W
Direction Indication Front Left	High Side Driver	59W/ 32W[3]	27W + 5W
Direction Indication Rear Left			27W
Direction Indication Front Right	High Side Driver	59W/ 32W[3]	27W + 5W
Direction Indication Rear Right			27W
Reverse Lamps	High Side Driver	54W	2 x 27W
Stop Lamps Left	High Side Driver	27W	-
Stop Lamps Right	High Side Driver	27W	-

[1] Licence Plate and Marker Lamps not to exceed 35W. LED Markers are recommended where available.

[2] +14W If Side, Roof or End Marker lamps are already fitted.

[3] Not combined Stop Turn/Combined Stop Turn. Turn Indicator Supply, smaller load will cause double flashing (bulb outage detection).

Lighting Fuses		
F9	10A	Main Beam Right Supply
F10	10A	Main Beam Left Supply
F11	25A	Exterior Lamp Right - Position Lamp Left
F14	25A	Turn Indicator, Roof mounted Stop Lamp
F15	25A	Exterior Lamp Left - Position Lamp Right

4.12.3 Lamps – Hazard/Direction Indication

NOTE: If LED lamps are used on the rear of a Camper modification, the wattage needs to simulate 32W not combined / 27W combined expected by the bulb outage detection circuit. Alternatively the BCM can be configured to use LED lamps without load resistors using the IDS (Integrated Diagnostic Systems Equipment) tool at a dealer. This deactivates the bulb failure detection that would otherwise be triggered by the low power consumption of the LED lamps. If LED indicators are supplemental to existing system, then the load resistor may not be required. When adding extra lamps, the vehicle modifier must check they comply to the legal requirements and that functionality is maintained.

The maximum not combined permissible load is 59W not combined /32W combined.

Changing between not combined and combined requires the BCM to be reconfigured using IDS.

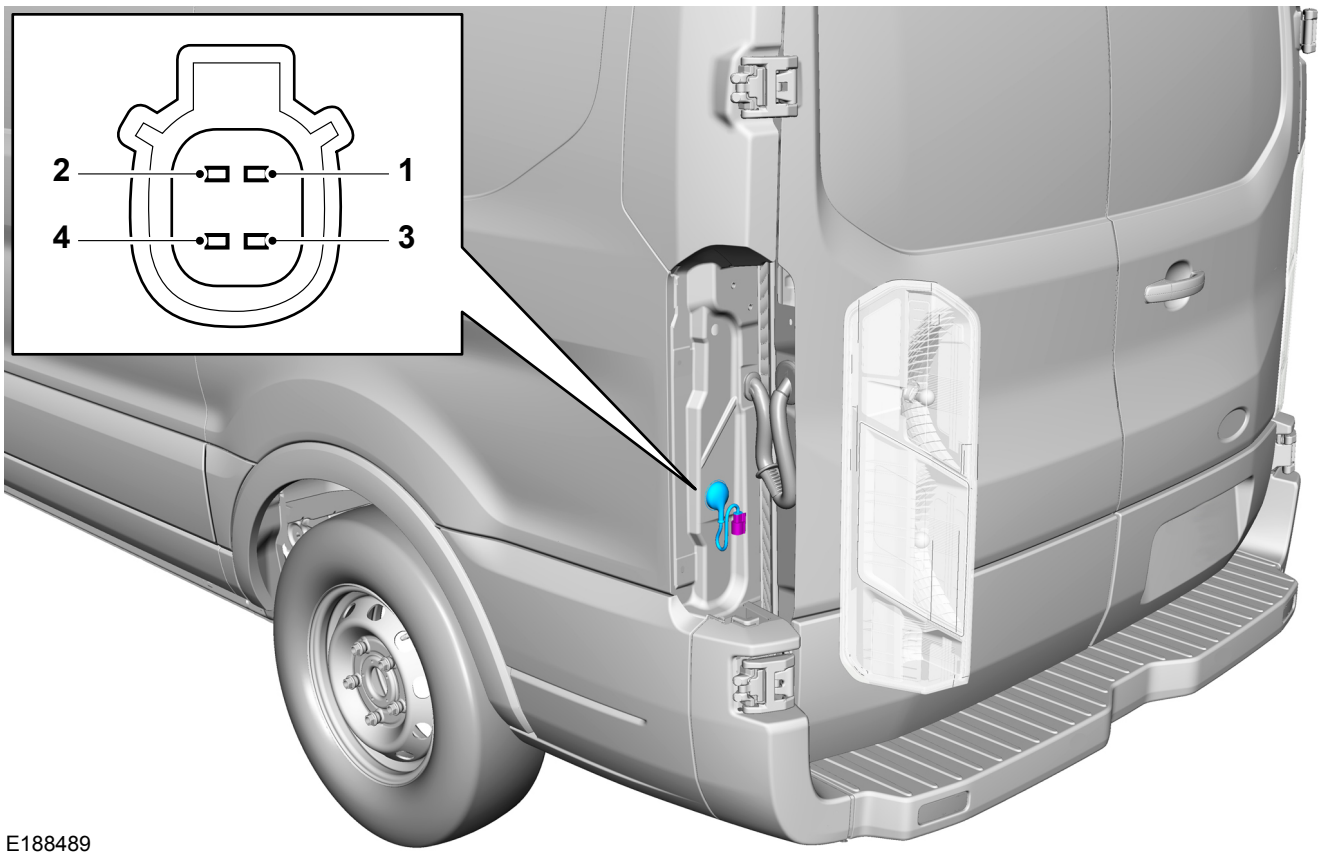
4.12.4 Electrically Operated Door Mirrors

WARNING: Do not tamper with the base system (controlled by Body Control Module and multiplex architecture) and any feeds taken from the associated wiring or controller.

NOTE: These options are not suitable for aftermarket or modifier fit.

4.12.5 Additional External Lamps

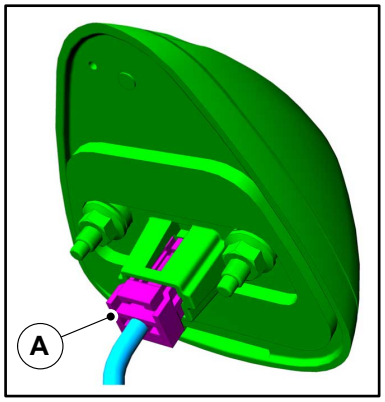
Rear Lamp Connector - Van, Wagon (Left Hand Side Shown)

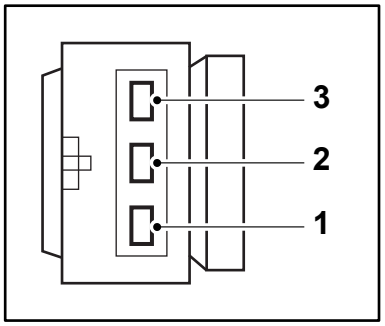


Rear Lamp Connectors - Van, Wagon			
Lamp Assembly Tail Right		**Lamp Assembly Tail Left**	
Harness			
Connector SRW			
Mating Connector SRW			
Connector DRW			
Mating Connector DRW			
Pin 1	Ground - Pillar D Right 2nd Point	Pin 1	Ground - Pillar D Left
Pin 2	Park Rear Right	Pin 2	Park Rear Left
Pin 3	Stop/Turn Right Outboard	Pin 3	Stop/Turn Left Outboard
Pin 4	Reverse Left or Common	Pin 4	Reverse Left or Common

SRW - Single Rear Wheel, DRW - Dual Rear Wheel

Front Roof Marker Lamps - Van, Wagon

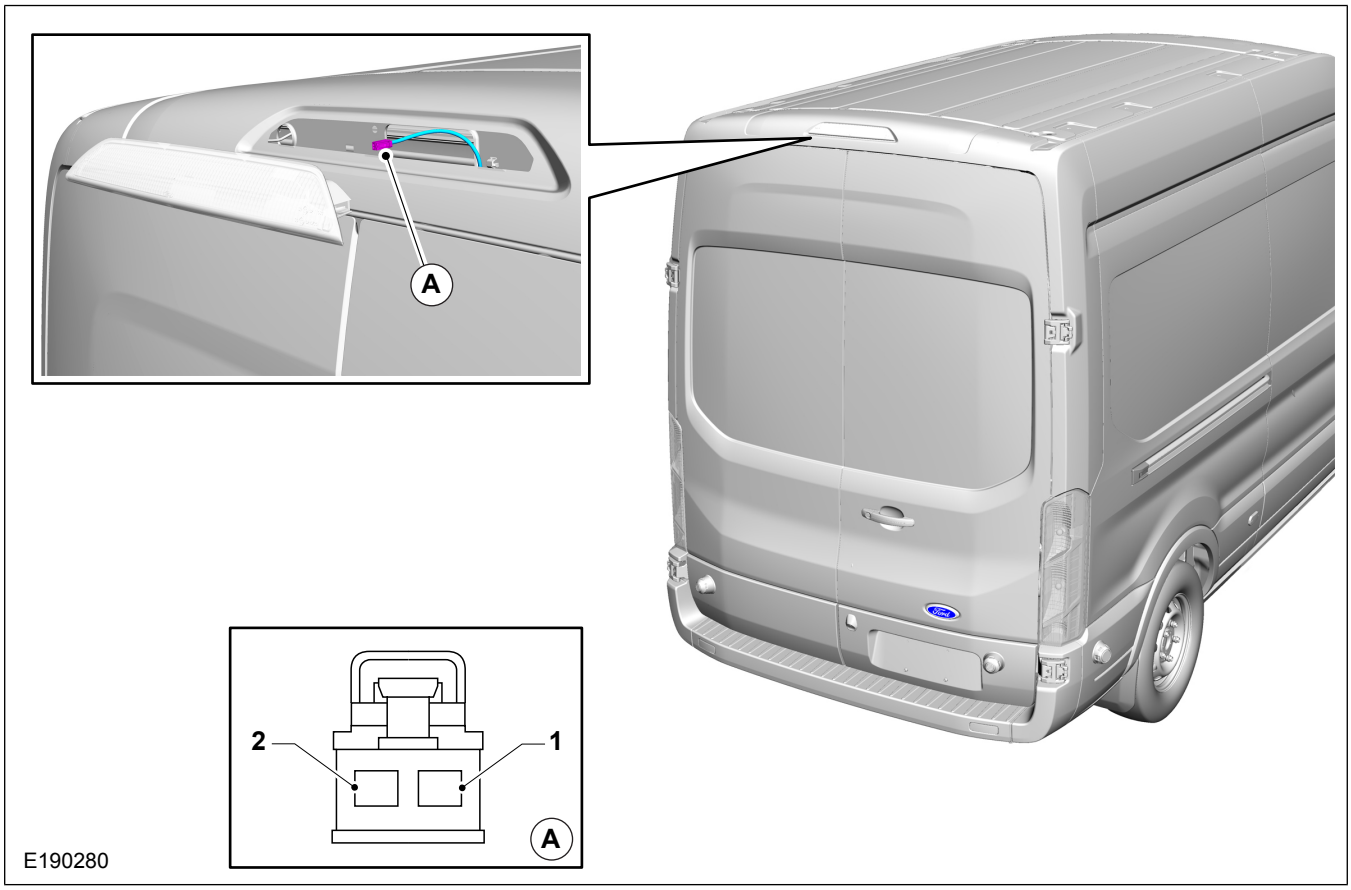




E188490

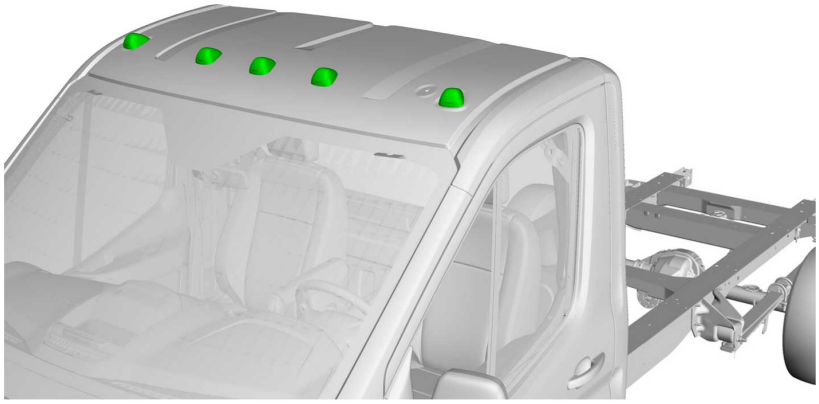
Front Roof Marker Lamps Van, Wagon (DRW	
Harness	
Connector	
Pin 1	Licence Plate Lamps/Marker Lamps
Pin 2	-
Pin 3	Ground - Pillar D Right/Left

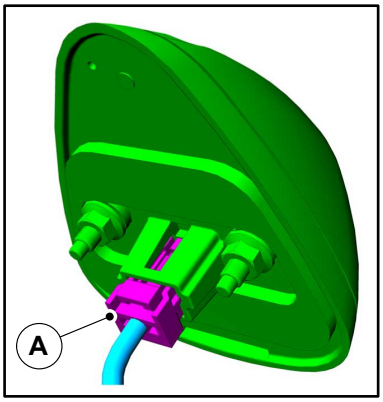
Rear Roof Marker Lamp Van, Wagon (DRW Jumbo)

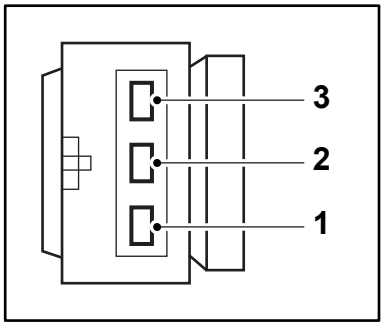


Item	Description
A	Rear Roof Marker Lamp Connector

Front Roof Marker Lamps - Chassis Cab/Cutaway





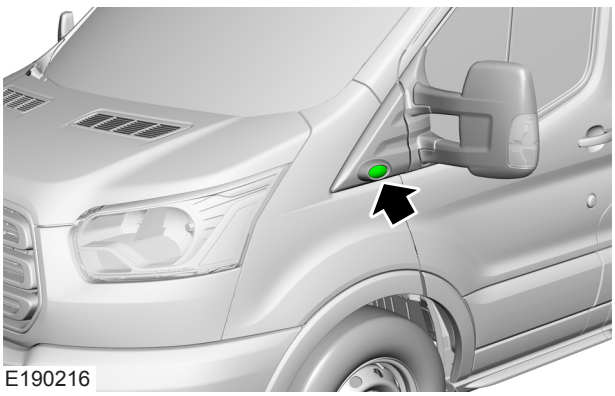


E188491

Front Roof Marker Lamps Van, Wagon	
Harness	
Connector	
Pin 1	Licence Plate Lamps/Marker Lamps
Pin 2	-
Pin 3	Ground - Pillar D Right/Left

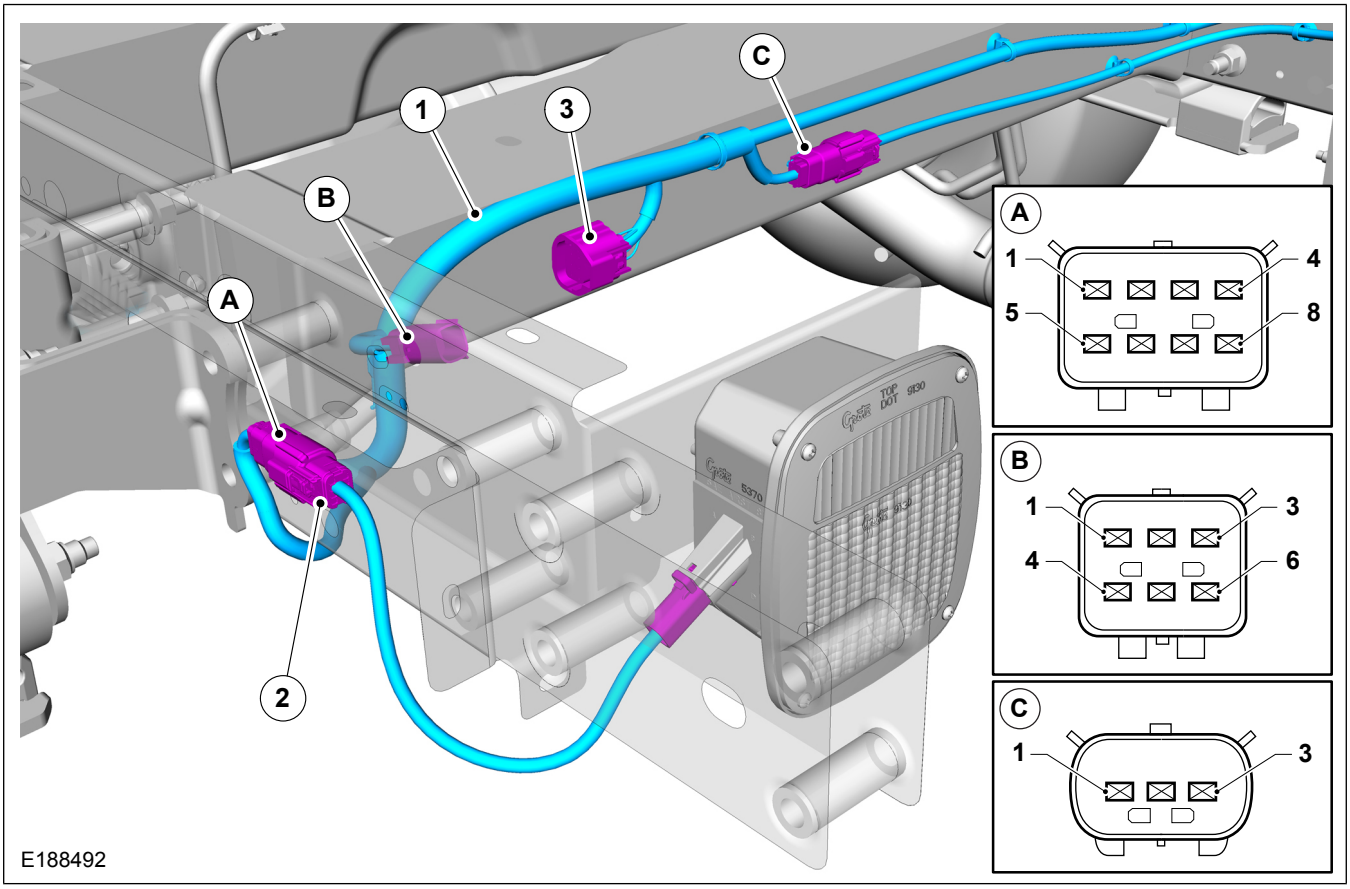
Side Clearance Lamp - DRW vehicles only

Side Clearance Lamp on Jumper harness



E190216

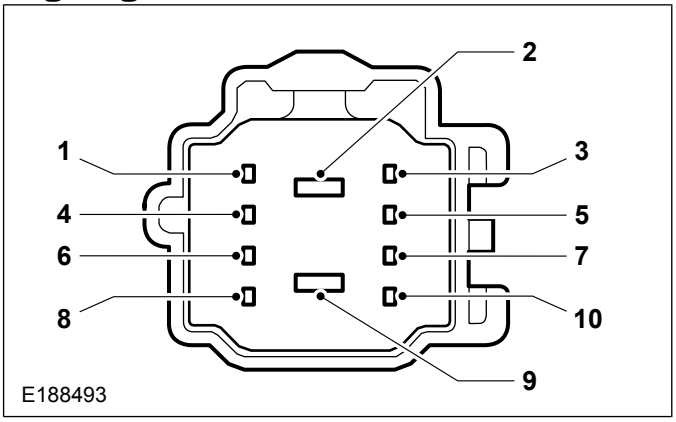
Rear Lamps - Chassis Cab/Cutaway (Left Hand Side Shown)



Rear Lamps - Chassis Cab / Cutaway (Left hand side shown)	
1	Fuel Tank Harness
2	Mating Connector on Harness
3	Trailer Tow Socket Connector
A	**Rear Lamp Connector - Main Harness 14406 - Mating Connector**
Pin 1	Stop/Turn Left Outboard
Pin 2	Turn Lamp Rear
Pins 3, 4	-
Pin 5	Park Lamp Rear
Pin 6	Backup
Pin 7	-
Pin 8	Ground - Frame Middle
B	**Licence Plate Lamp Connector - Main Harness 14406 - Mating Connector**
Pins 1 + 4	Licence Plate Lamp
Pin 2	-
Pins 3 + 6	Ground - Frame Middle
C	**Stop Lamp High Mount - Main Harness 14406 - Mating Connector**
Pin 1	Stop Lamp High Mount
Pin 2	-
Pin 3	Ground Frame Middle

Additional Position Lamps at the Rear of the Vehicle

Lighting Connector



Item	Description
Pin 8	Position Lamps

The feed for position lamps can be taken from the right back door inline connector, at the rear right hand side of the vehicle on 13A409 harness, pin 8 (yellow/violet), see figure E188493 or direct from the licence plate feed connector, see figure E188492 The maximum load is 23W per side.

NOTE: Lighting connector shown in E188493 will require a local ground.

The position and parking functions operate independently.

Where applicable, when the position lamps are extinguished, the end-outline markers turn off simultaneously, in line with Inter Regs No 48, which states the following:

The electrical connections must be such that the front and rear position lamps, the end-outline marker lamps (if they exist), the side-marker lamps (if they exist) and the rear registration plate lamp can only be switched on and off simultaneously.

Connecting to Lighting Information

Additional turn indicators must be powered through relays (max 300mA), driven by existing turn lamps. The maximum load that the Body Control Module (BCM) can drive is 59W not combined Stop Turn (front, side, rear), 32W combined Stop Turn (front, side).

The reverse tail lamp cicuits are unable to support any additional load. Equipment that requires a reverse signal should use the reverse trailer tow. For more information

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).
Trailer Tow Connectivity.

4.13 Interior Lighting

4.13.1 Additional Internal Lamps

Additional cabin interior lighting may be obtained by directly accessing the connector inside the dome lamp in the cabin.

Additional load space interior lighting may be obtained by directly accessing the connector inside the load space lamps in the load space area.

CAUTION: The maximum total internal lamp load must not exceed 7A (105W).

Power for the Interior Lamps - Cabin and cargo areas come from the battery save system (Body Control Module pin C2-9). The circuit for each area is controlled by a separate pin on the Body Control Module (BCM):

- Front (cabin) lamps, pin C2-2
- Rear (cargo) lamps, pin C2-1

For additional information on BCM

Refer to: 4.2 Communications Network (page 61).

All vehicles utilize the battery saver relay to provide power for internal lighting for a limited time.

- 75W max output for front cabin lamps
- 75W max output for rear cargo lamps
- 105W battery save output (total front and rear)

Each of these pins on the Body Control Module can take a load of 75W.

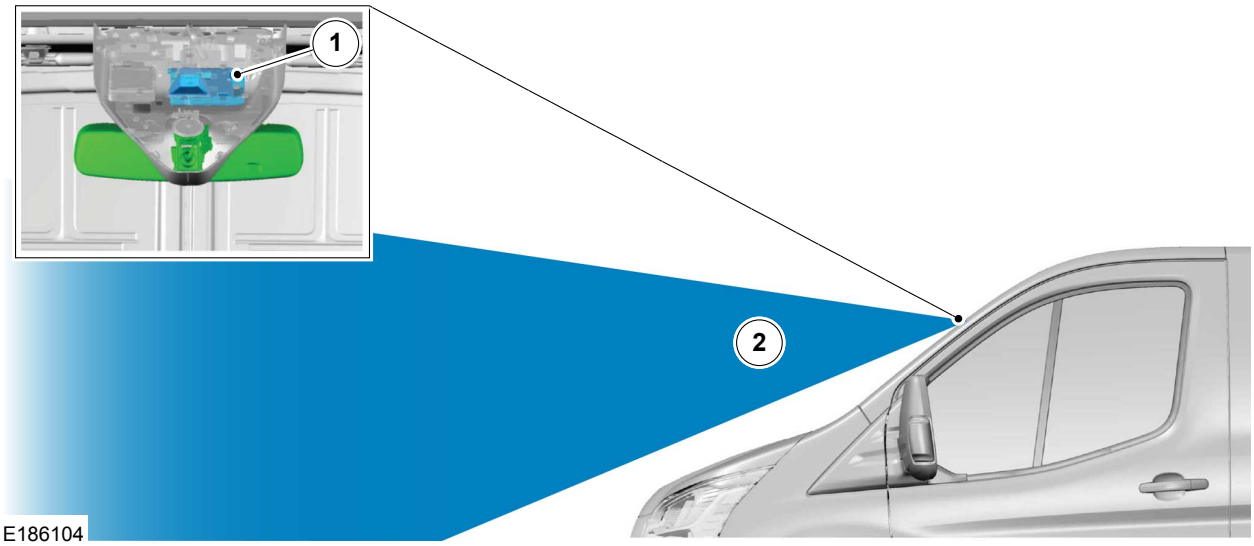
If fluorescent lighting is required it must not be connected to the existing interior cabin or cargo lighting as it is not compatible with the pulse width modulated (PWM) lighting circuit and may cause premature failure of the Fluorescent lighting. If Florescent lighting is required, it should be connected to the Auxiliary Fuse Panel.

If enhanced bright lights are required for the cargo area of a van, it is recommended to fit the Ford Enhanced Load Space Lighting. Option A080 and LED lamp part numbers BK2V-13776-A*, 4x on medium (L2) and long (L3) wheelbase vehicles and 5x on extra long (L4) wheelbase vehicles. These are controlled from the side load or rear door being ajar or manual demand from the dome lamp in the front cabin. The default setting is 30 minutes from the battery saver system. For further information on required parts and configurations to order contact your local Ford dealer.

4.14 Lane Keeping System

NOTE: The lane keep alert feature will not function if any conversion or installation is in the field of view from the lane keeping system camera.

NOTE: For converted vehicles fitted with lane keeping system, where vehicle mass or geometry is significantly altered, a new calibration for the camera sensor needs to be made.



Item	Description
1	Lane keeping system camera located behind the interior rear view mirror trim
2	View cone from camera, horizontal direction and downwards to the hood edge of the vehicle

For additional information for vehicles with large overhangs

Refer to: 4.17 Special Conversions (page 126).

4.15.1 Door Removal or Modification

In the event of the requirement to remove the doors for derivatives requiring no doors, certain circuits will need to be linked to ensure door ajar warnings do not appear on the Instrument Cluster. The interior light will also stay on if this is not done.

It is possible to maintain a certain state by configuring the Body Control Module (BCM) C3 in the following way.

- C3-44 Front Left
- C3-34 Front Right
- C3-35 Ajar left side cargo switch
- C3-51 Ajar left side cargo switch

4.15.2 Central Locking

Locking is controlled by the BCM. There is current sensing on certain locking circuit pins as part of the security system – if these are tampered with, locking cannot be guaranteed.

However, it is possible to add an additional lock(s) – see also the section covering the 'third button on key fob' – but only by utilizing relays (the electric locks are operated by surface mounted relays in the BCM – these are only capable of powering one lock each, in addition to which the output of these devices is current-sensed to check it is within minimum and maximum limits: I) to verify operation, and ii) as part of the security system).

Depending on functionality required, the pins used will emulate the basic locking/unlocking operation of an existing door. Note, however, that any additional locks will not be covered by the vehicle alarm or operate BCM controlled lighting. It would be necessary to splice into either the BCM connector or the in-line connector for the door jumper harness. The coil of the relay (max. 300mA) should be added across the relevant pin and ground (i.e. one relay for lock all, one relay for driver door unlock etc).

The use of Ford Transit lock mechanisms is strongly recommended as the BCM is designed to drive these latches for the correct amount of time.

BCM	14A631 in-line Drive Side	14A631 in-line Passenger Side	Function
C2-18	8	8	Lock Left
C2-27	8	8	Lock Right
C2-39	17	-	Driver Door unlock
C2-44	-	-	Rear Cargo Door unlock
C2-45	-	17	Passenger Door unlock

Locking Configurations The following list details specific locking scenarios that have been noted by customers:

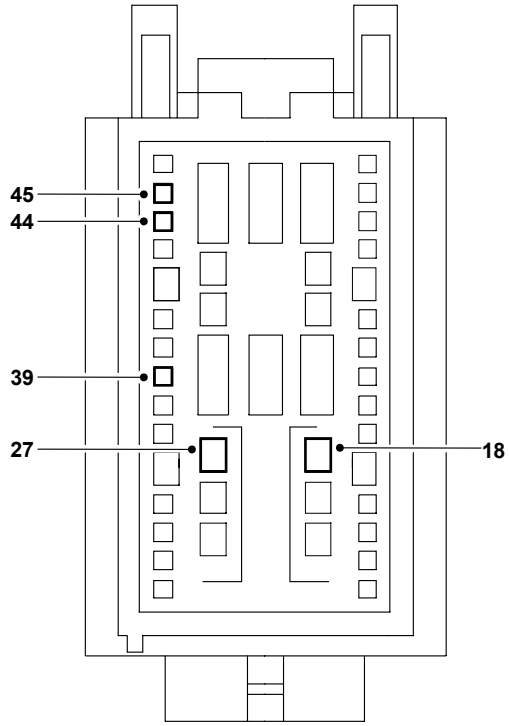
1. Raid locking or drive away locking for taxi and parcel van usage – this is a configurable parameter in the BCM (Ford Dealerships can set this). There is also the option to configure via the instrument cluster once the configurable parameter has been set.
2. Slam locking – this is a configurable parameter in BCM (dealerships can only switch off this feature, but not switch on).
3. N1 lock reconfiguration into no deadlocks – this can be reconfigured to be central-locking only by a Ford Dealer (via Dealership hotline).
4. Auto unlock - There is an option to configure central unlock where the drivers door, when opened, will automatically unlock all doors except any doors controlled by the third button on the key fob.

Drive-Away Locking Disable

The following parameter (automatic locking by speed) is configured as follows:

- IDS parameter 32 - Change 0x02 [on] to 0x01 [off].

Pins to Control Additional Door Locks



E190676

Item	Description
Pin 18	Left Lock Supply (Driver Lock)
Pin 27	Right Lock Supply (Passenger Lock)
Pin 39	Driver Door Unlock Supply
Pin 44	Rear Cargo Door (Van, Wagon) or Key Fob Signal (Single Chassis Cab)
Pin 45	Passenger Door Unlock Supply

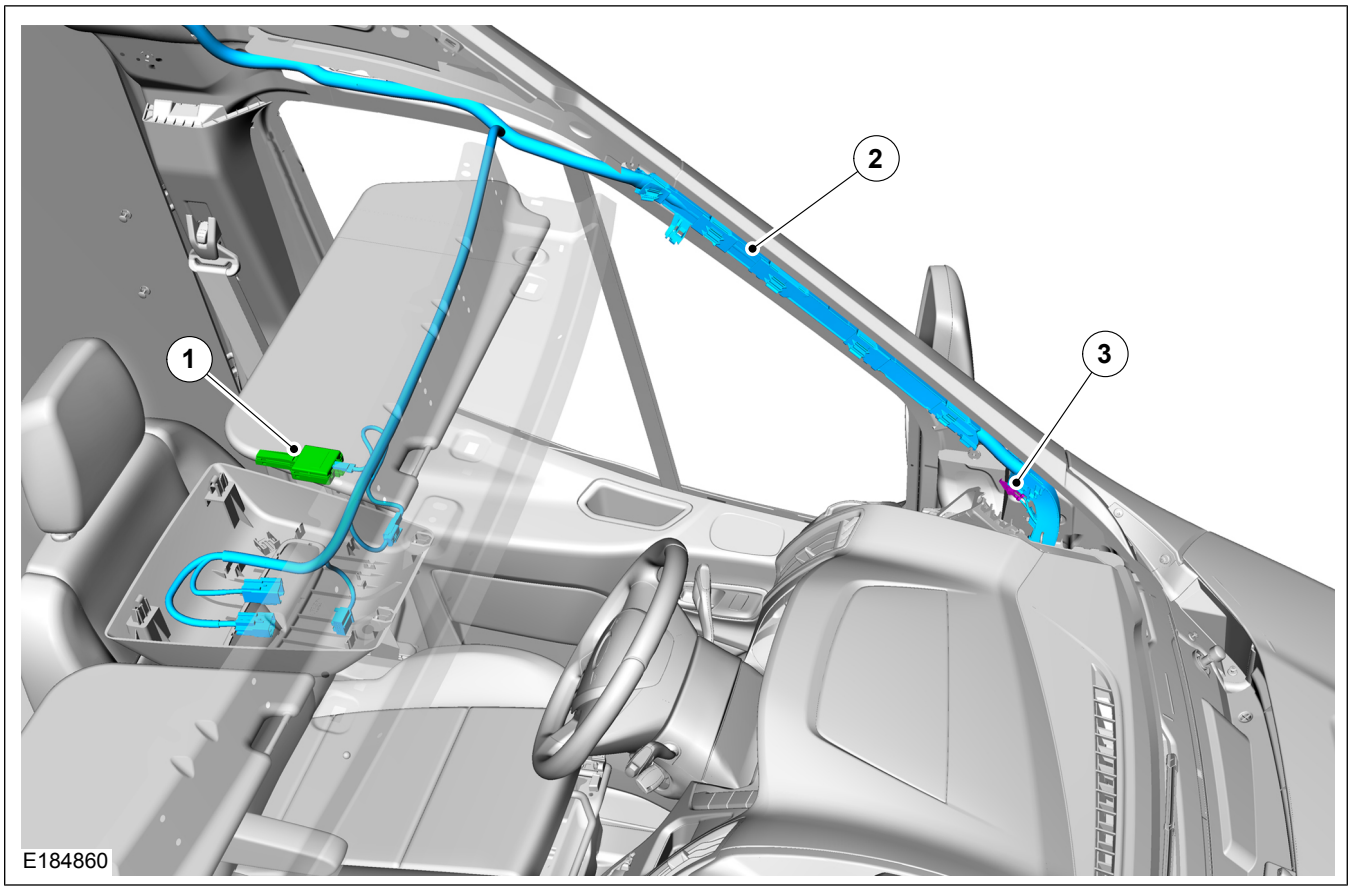
4.15.3 Third Button on Key Fob - Single Chassis Cab and Transit Motorhome Chassis Only

Pin 44 on connector C2 of the Body Control Module (BCM) is controlled by the third button on the key fob. Please refer to figure E145374. This provides a 12V pulse when pressed. The signal can be used for a variety of modifier applications, subject to load required.

Pin C2-44 is part of the circuit protected by a 15A fuse (F1).

NOTE: There are no micro switches, no current sensing, or any alarm system functionality associated with this pin, or any lock set driven by it.

4.15.4 Remote Keyless Entry/Tire Pressure monitoring System Receiver (RKE/TPMS Receiver)



Item	Description
1	RKE/TPMS Receiver
2	Harness 13A409
3	Ground Point Location

WARNING: For best performance, the RKE/TPMS receiver must be a minimum distance of 1" (25mm) away from any metal objects and 3.9" (100mm) away from high switch loads.

NOTE: It is recommended that the RKE/TPMS has a dedicated ground wire and ground stud, do not splice with other modules.

The RKE/TPMS receiver is fed via a connection to the 13A409 harness and then earthed at the ground point located on the A-Pillar. For ground point location

Refer to: 4.19 Grounding (page 150).
For additional information
Refer to: 2.4 Wheels and Tires (page 28).

4.16 Fuses and Relays

4.16.1 Fuses

WARNING: No increase in existing vehicle standard fuse capacity is allowed under any circumstances. There are no spare fuses in the Engine Junction Box (EJB), Standard Relay Box (SRB) or Body Control Module (BCM). The vehicle modifier must provide additional fuses as required. Please refer to Ford Fuse table in this section.

NOTE: Only use Ford fuses as shown in the next table. Other fuses may interfere with the validated fusing strategy.

Ford Fuses

Ampere Rating	Color
Mini Fuse	
2A	Gray
3A	Violet
4A	Pink
5A	Tan
7.5A	Brown
10A	Red
15A	Blue
20A	Yellow
Midi Fuse	
60A	Yellow
J-Case Fuse	
20A	Blue
30A	Pink
40A	Green
50A	Red
60A	Yellow

4.16.2 Relays

Ford Relays

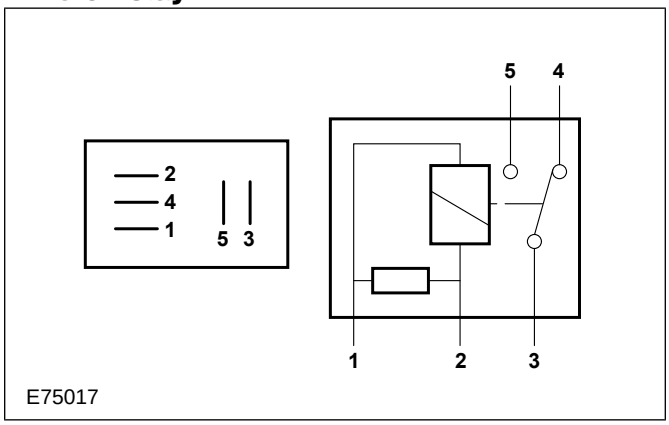
Ampere Rating	Color
Mini Relay	
70A	Gray
40A	Black
40A	Black
Micro Relay	
20A	Black
20A - Silent/Low Noise Relay	Gray

NOTE: Only use the Ford Relays shown in table.

Ford standard relays have a nominal coil current of 300mA (max) at 77°F (25°C). Relays with higher loads should not be used.

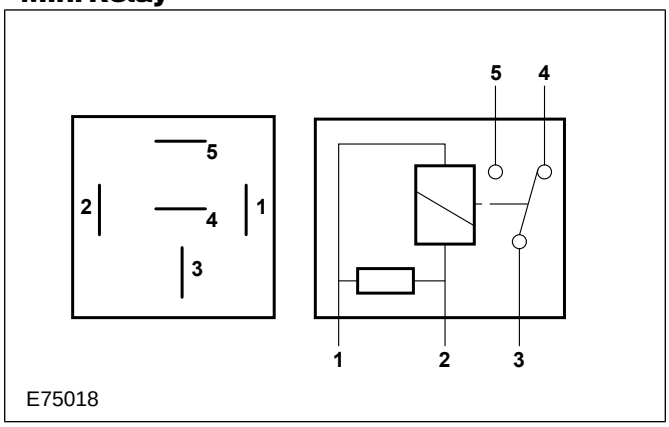
For maximum switching currents please refer to Relay Figures E75017—E75021.

Micro Relay



Micro Relay Parameters	
Open contacts	20 Amps
Closed contacts	16 Amps
Nominal coil current	300 mA (max)
Medium current changeover relay	
Medium current normally open relay (pin 4 not present)	

Mini Relay



Mini Relay Parameters	
Normally open contacts	40 Amps
Normally closed contacts	20 Amps
Nominal coil current	300 mA (max)
Medium current changeover relay	
Medium current normally open relay (pin 4 not present)	

4.16.3 Windshield Wipers

The base wiper system should not be tampered with (controlled by BCM and multiplex architecture with LIN technology).

NOTE: Power to wiper motors is limited by the size of the wiring and associated relays. If any alternative wiper installation is made, it must have a specification equivalent to Ford components.

Refer to: 5.9 Glass, Frames and Mechanisms (page 187).

4.17 Special Conversions

4.17.1 Harnesses and Aftermarket Kits

WARNING: Only Ford release wiring should be used to support added vehicle functionality. If the implementation of wiring other than this is required, Ford guidelines must be followed.

NOTE: The Auxiliary Fuse Panel should be ordered

Refer to: 4.16 Fuses and Relays (page 124).
Refer to: 4.19 Grounding (page 150).

In addition to the Auxiliary Fuse Panel, a number of other kits are available to meet customer needs, contact your local Ford Dealer for details.

4.17.2 Additional Vehicle Signals/Features

WARNING: When interfacing with specific lighting high side driver outputs, additional supplemental signal access, relays and peripherals fitted, must be compatible with a Pulse Width Modulation (PWM) frequency of 200Hz.

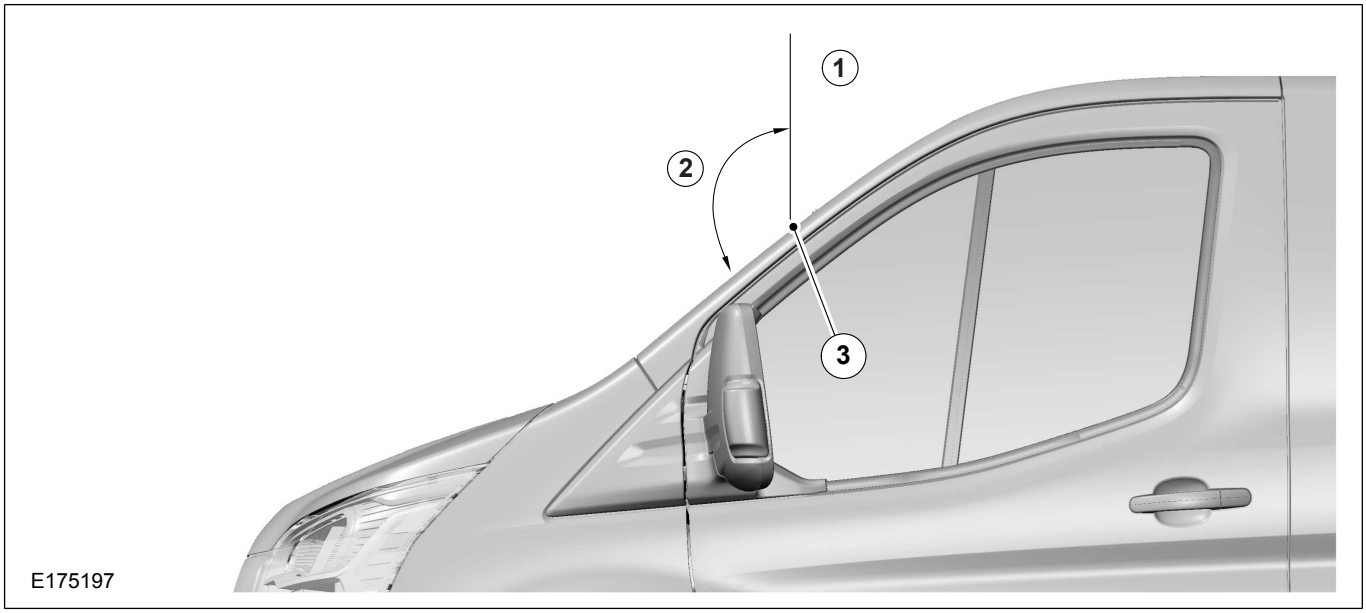
For list of lighting circuits that are PWM supplied:

Refer to: 4.2 Communications Network (page 61).
BCM Output Information table.

For additional information on lighting loads

Refer to: 4.12 Exterior Lighting (page 111).

4.17.3 Auto Wipe and Auto Light for vehicles with large overhangs



Item	Description
1	Zone 1 - Modification or Installation rearward where Auto Light and Wipe feature will function correctly.
2	Zone 2 - Modification or Installation forward (132°) where Auto Light and Wipe feature will NOT function correctly — The feature is not to be specified with the donor or configured OFF by the Ford dealer.
3	Auto sensor location.

NOTE: The Auto Wipe, Auto Light feature should not be ordered for vehicles that are to be built where the installation covers any part shown forward of the vehicle see figure E175197. This will affect the auto sensors ability to detect light or moisture to the defined calibration and will not function correctly.

In the event that a donor vehicle has been supplied with these features, the dealer can configure the vehicle to manual light and wipe with the following settings.

- Set Central Car Configuration parameter 24 – With Rain sensor to 01: (Without Rain Sensor)
- Parameter 88 for Auto Light should be set to 01: (Without Auto Lights)

It is also recommended that the Auto Light main switch is changed for a non auto switch. If not changed when selecting auto position (A), the dipped beam will remain on (due to a not valid condition) and the system will run in fail safe mode. Dipped beam will be operated at Ignition on and with Engine RUN. If the wiper is selected with the light switch in (A) the wiper will work as if intermittent mode has been selected. A Ford Dealer can help advise which switch should be ordered and fitted, depending on the specification of the vehicle.

4.18 Electrical Connectors and Connections

4.18.1 Connectors

Cutting into the Original Wiring System

WARNINGS:

Under no circumstances should the CAN Bus be tampered with. This may lead to failure of safety critical components such as Anti-Lock Brake System.

Do not use connectors which cut through the outer covering and into the core wire.

CAUTION: Only use Ford approved connectors.

NOTE: Ford approved jumper harnesses should be used.

It is not recommended to cut into vehicle wiring because:

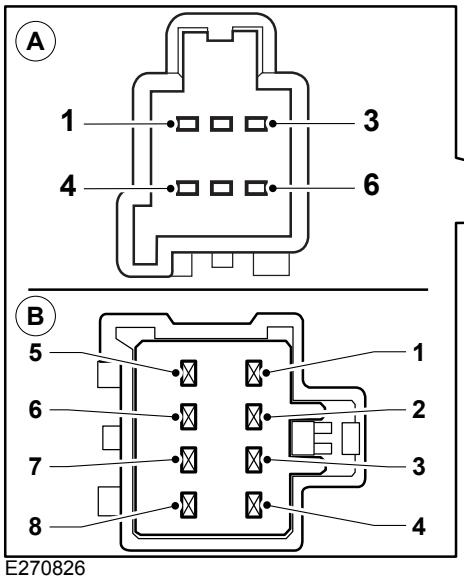
- The base vehicle specification is unsuitable for incremental loads except in conjunction with Auxiliary Fuse Panel
- Long term risk of a faulty connection developing
- Potential fire risk from over-loading

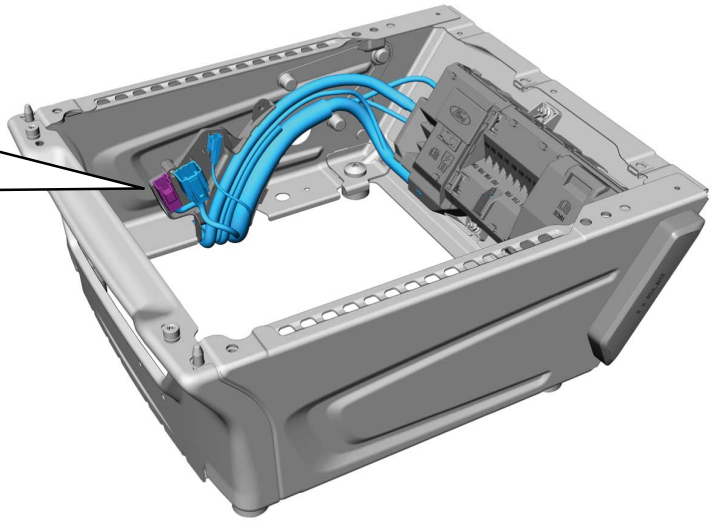
All connections into existing wiring must be permanently insulated. Exterior connections must be water-proof and with a drip loop.

Where wires are required to be extended, break in points should only be at existing connector points. If splicing into existing wiring is unavoidable, see wiring splicing procedures in this manual.

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).

4.18.2 Vehicle Interface Connector C33-E





E270826

NOTE: Vehicles built before 2018MY will have 6 way- connector A and vehicles built starting 2018MY will have 8 way - connector B. See figure E270826 for location and the following table for signals.

The Vehicle Interface Connector is on every vehicle and provides a direct interface to useful signals.

6 Way- Connector A		8 Way - Connector B	
1	Turn Lamp Left Front	1	Ground
2	Turn Lamp Right Front	2	Engine Run
3	Engine Run — Ground	3	Turn Lamp Left Front
4	Vehicle Speed	4	Turn Lamp Right Front
5	Switch Illumination	5	Vehicle Speed
6	Ignition	6	Ignition
		7	Switch Illumination
		8	12V+ Batt

WARNINGS:

Signals 3 to 5 on the Vehicle Interface Connector are for sensing purposes only and not to be loaded by high current consumers. The max current rating for signal 6 is 10A and not to be exceeded in any situation.

Unused wires in the service kit must have cable ends insulated to avoid shorting on any ground points.

Vehicle Speed

Square Wave Characteristics

Specifications	
Max High Signal	Battery Voltage
Min High Signal	3.67 Volts
Max Low Signal	1.1 Volts
Min Low Signal	- 1.1 Volts
Max Ground Offset	± 1.0 Volts
Rise Time	10µ sec <= tr <= 250µ sec
Fall Time	10µ sec <= tf <= 250µ sec
Duty Cycle	50% ± 10%
Pulse Rate	2.2 Hz/MPH (1.3808 Hz/KPH)

WARNING: Do not interface with the CAN (Controller Area Network) for vehicle speed.

Pin 4 - Vehicle Speed signal is a direct current coupled square wave that varies in frequency in proportion to vehicle speed. This provides a square wave-form (50% duty cycle) signal, where a frequency of 138Hz equates to 100km/h.

Switch Illumination

Pin 5 - Switch Illumination signal is only to be used for sensing or to control a relay. It is +12V for: side lights, dipped, full beam and auto light mode (when lights are on) at switch positions. A daytime running lamp vehicle will still need to have the light switch to control this signal.

Engine Run

WARNING: Do not cut into the alternator wires or use the alternator as a source to obtain a 'D+ Signal'.

Pin 3 - Engine Run signal will only support a sense line or relay control.

This engine run signal is ground switching (max current sink 250mA), it provides no positive output (open circuit) and is only active when the engine is running.

The signal will not be present when:

- Key states - OFF (0), Accessory (1), Run but Engine OFF (2), Crank (3)
- Engine running but load is greater than 250mA (driving two or more relays in error)

The fitment of the Auxiliary Fuse Panel will provide a power +12V side for the relay (although connection to the engine run pin is still required). See Auxiliary Fuse Panel circuit diagram later in this section.

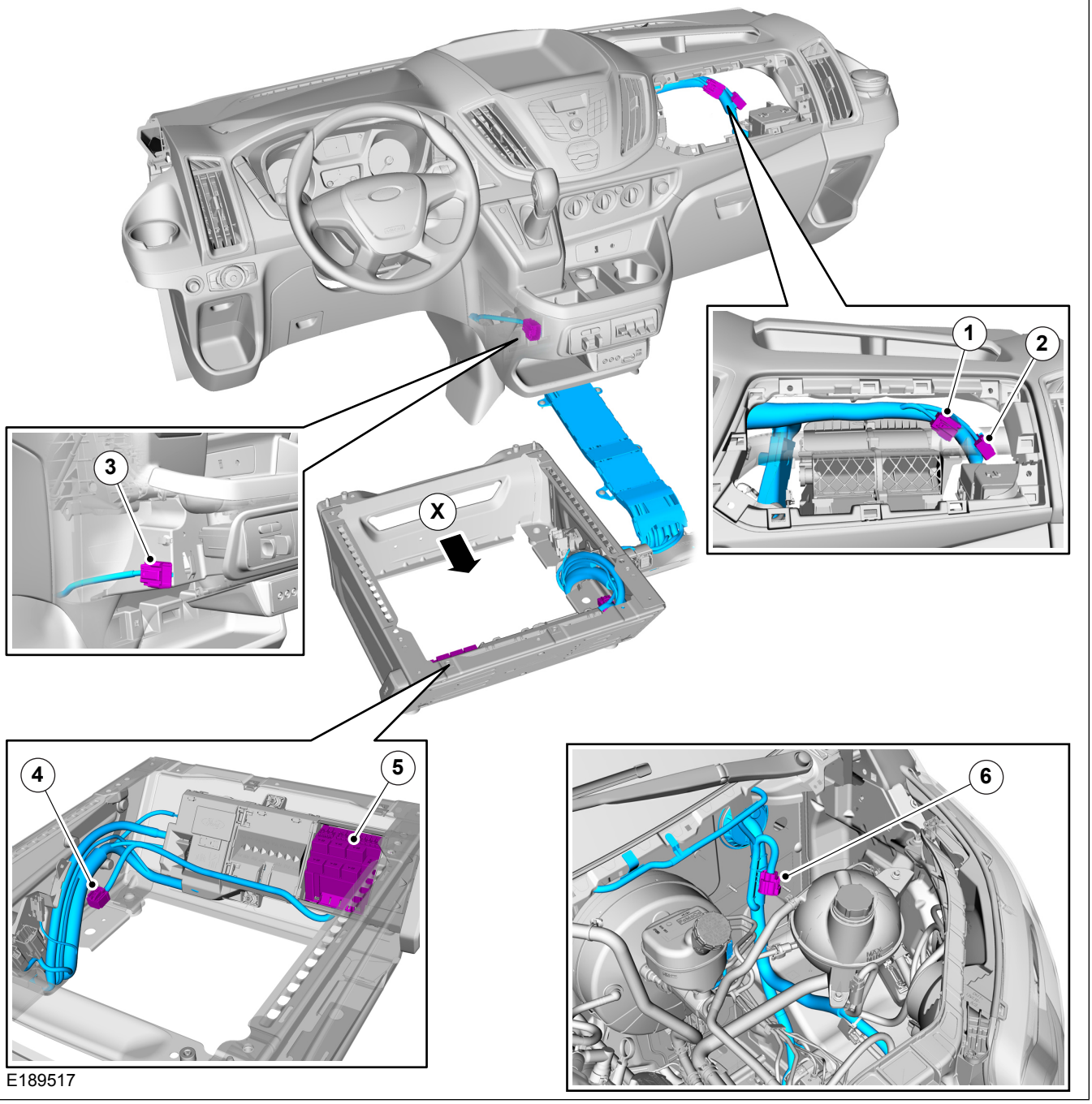
If a positive (+12V) engine run signal is required, it can be done by using the switched ground to control an ignition fed relay, to give this output.

Ignition

Pin 6 - Ignition signal is protected by a 10A fuse. It is +12V active at ignition positions: Accessory (1) and Run (2). It is not active at Ignition OFF (0) or Crank (3). Whilst it can drive equipment directly it is recommended to use this feed to control a modifier fitted relay, especially for high current applications.

4.18.3 Auxiliary Fuse Panel

Auxiliary Fuse Panel and Modified Vehicle Wiring Connectors - Vehicles built before June 2016

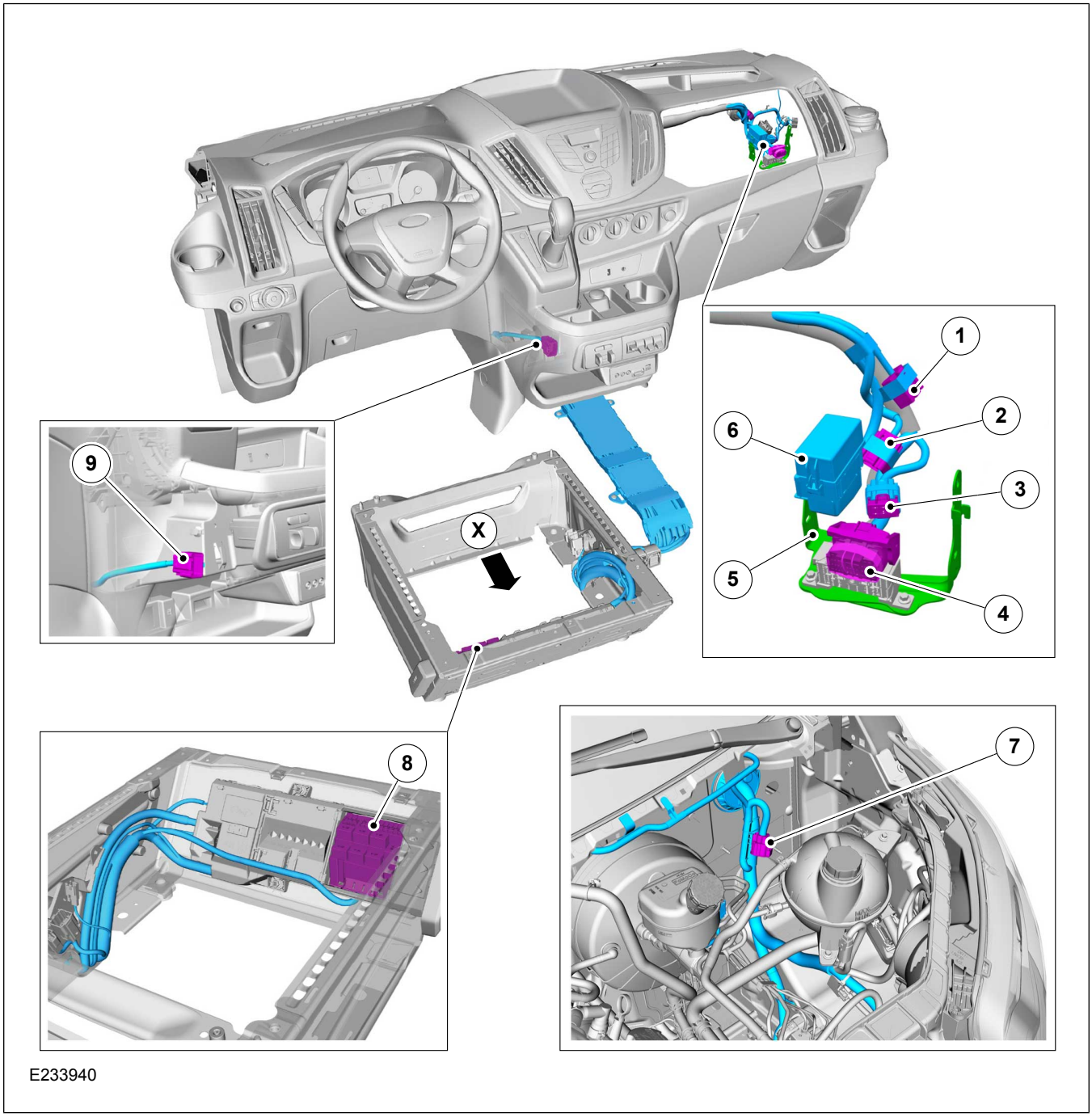


E189517

Item	Description
1	C33-D Connector
2	C33-C Connector
3	C12-A Connector
4	C33-H Connector
5	Auxiliary Fuse Panel
6	C11-H Connector - located in the engine bay

The Auxiliary Fuse Panel is integrated into Upfitter 14401 Main Wiring Harness and uses the Vehicle Interface, shown in figure E270826. This fuse panel is located within the drivers seat pedestal.

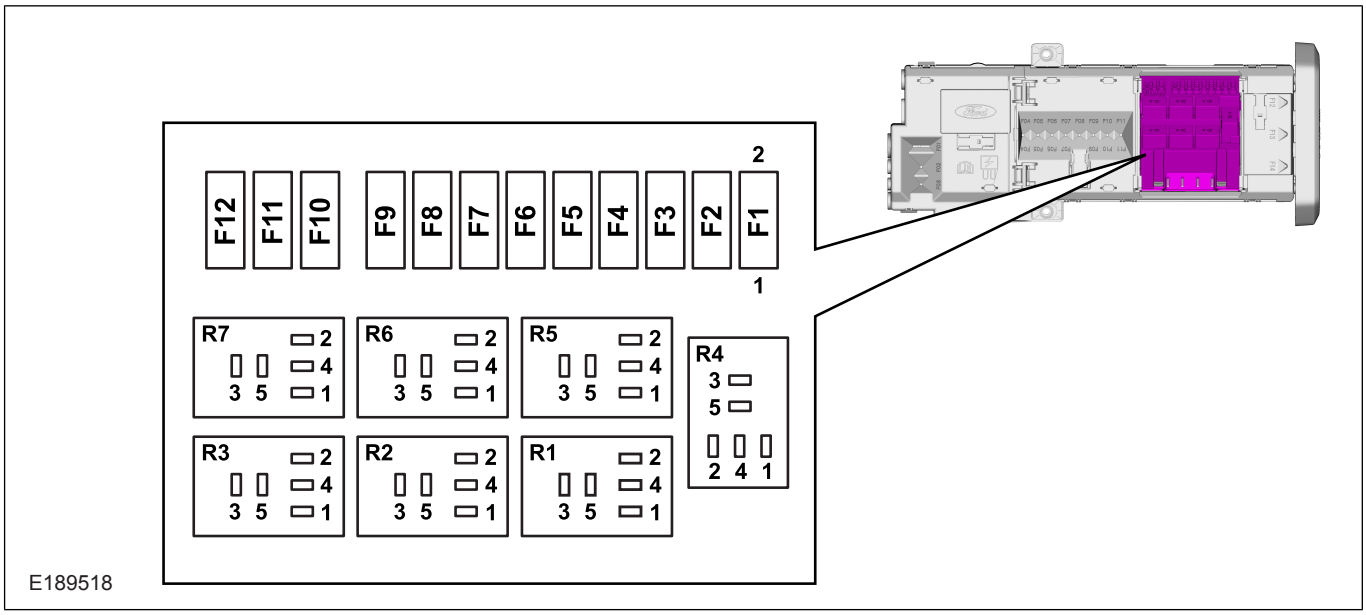
Upgraded Auxiliary Fuse Panel and Modified Vehicle Wiring Connectors with High Specification Interface Connector - Vehicles Built After June 2016



E233940

Item	Description
1	C33-D Connector
2	C33-C Connector
3	C33-H Connector
4	High Specification Vehicle Interface Connector
5	Auxiliary Fuse Box Bracket
6	Auxiliary Fuse Box
7	C11-H Connector - located in the engine bay
8	Upgraded Auxiliary Fuse Panel
9	C12-A Connector

Auxiliary Fuse Panel

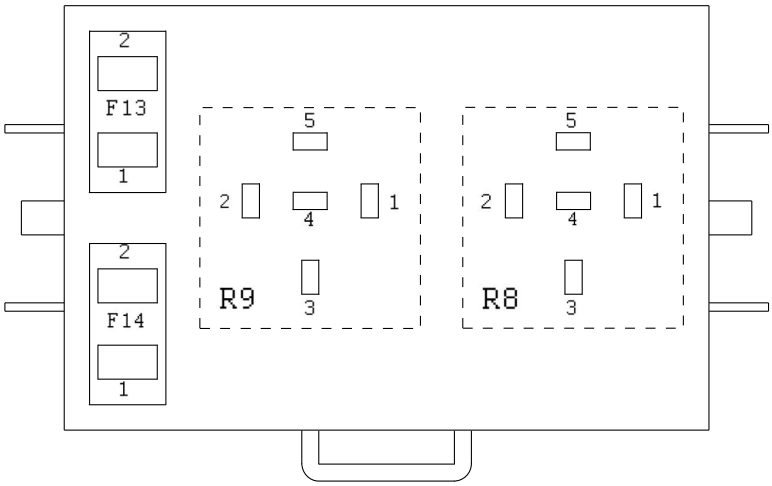


Auxiliary Fuse Panel				
Fuse No.	**Type**	**Value (A)**	**Color**	**Function**
F1	Mini	-	-	Spare
F2[(1)]	Mini	3	Gray	KL30 Feed
F3	Mini	-	-	Spare
F4	Mini	-	-	Spare
F5	Mini	20	Yellow	R4 Power
F6	Mini	20	Yellow	R3 Power
F7	Mini	20	Yellow	R2 Power
F8	Mini	20	Yellow	R1 Power
F9	Mini	-	-	Spare
F10[(1)]	Mini	3	Gray	Ground Control
F11[(1)]	Mini	3	Gray	Ground Control
F12	Mini	3	Violet	Switch Power

Relay No	**Value (A)**	**Relay name**	
		Vehicles Built Before June 2016	**Vehicles Built After June 2016**
R1	20	Upfitter 1	Upfitter 1
R2	20	Upfitter 2	Upfitter 2
R3	20	Upfitter 3	Ignition Hot ON
R4	20	Upfitter 4	Ignition Hot ON
R5[(1)]	20	Spare	Upfitter 5
R6[(1)]	20	Spare	Upfitter 6
R7	-	Spare	Spare

[(1)] = Vehicles built after June 2016

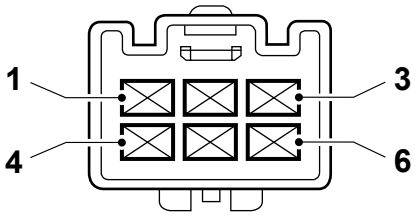
Auxiliary Fuse Box - Vehicles Built after June 2016



E236478

Auxiliary Fuse Box				
Fuse No.	**Type**	**Value (A)**	**Color**	**Function**
F13	J-Case	40	Green	R8 Power
F14	J-Case	40	Green	R9 Power
Relay No	**Value (A)**		**Relay name**	
R8	40		Upfitter 3	
R9	40		Upfitter 4	

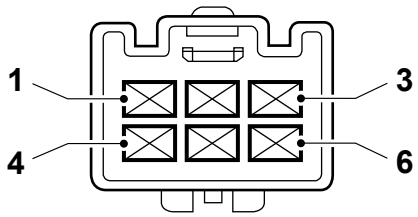
C33-C Connector



E190472

Item	Description
1	Ground - Cowl Side Pillar
2	Not Used
3	Fuse 53 (Modified Vehicle Wiring) VBATT (40A)
4	Not Used
5	Relay 52 (Modified Vehicle Wiring) VPWR (40A)
6	Fuse 18 (Upfitter Connector) VBATT (40A) Battery Fused Feed

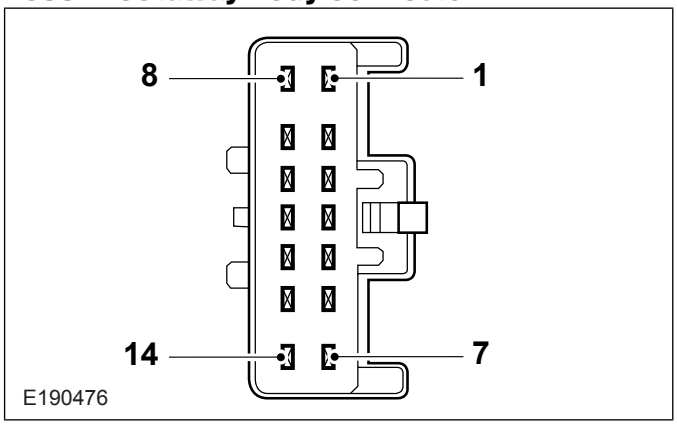
C12-A Connector



E190473

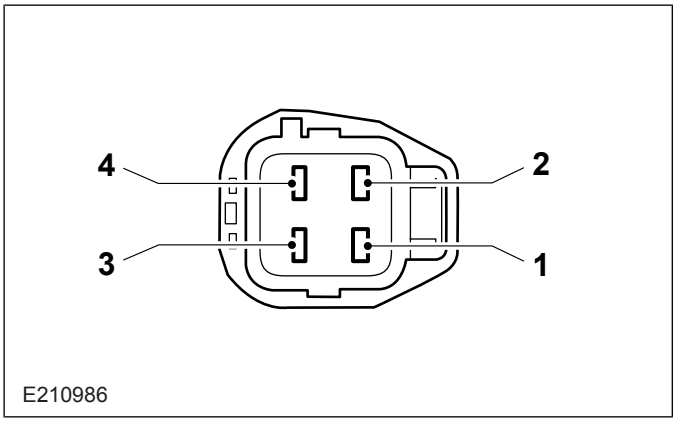
Item	Description
1	Upfitter Customer Access Pass Thru
2	Upfitter Customer Access Pass Thru
3	Fuse 53 (Modified Vehicle Wiring) VBATT (40A) Battery Fused Feed
4	Fuse 52 (Modified Vehicle Wiring) VPWR (40A) Run/Start Fused Feed
5	Front Left Lamp Turn
6	Front Right Lamp Turn

C33-D Cutaway Body Connector



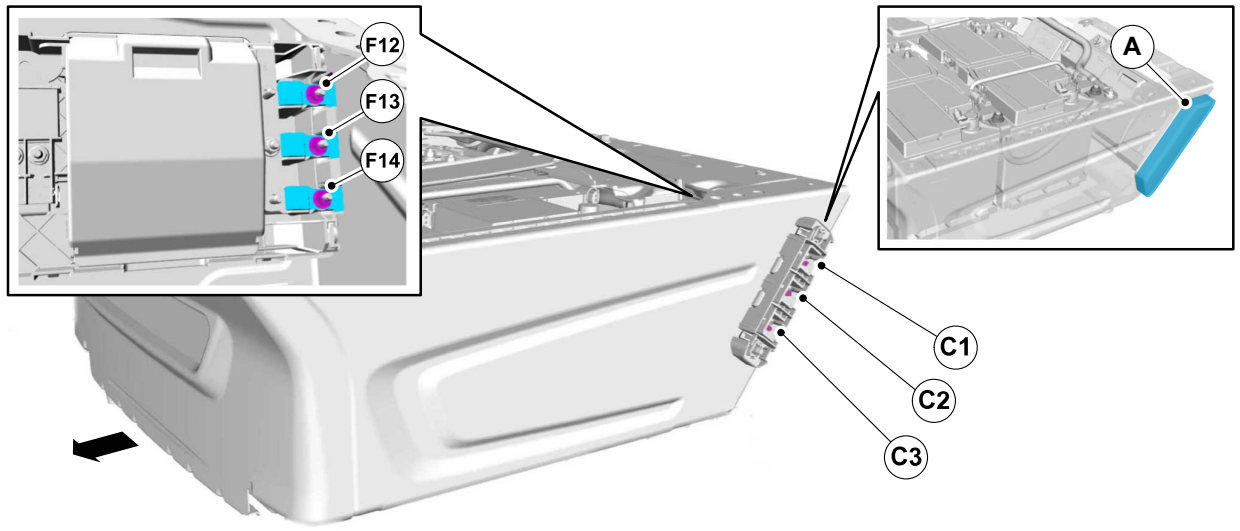
Item	Description
1	Fuse 24 (Upfitter Connector) (10A)
2	Audio Speaker R-Rear
3	Audio Speaker R-Rear
4	Entry Illumination Rear
5	Leaf Rear Door Ajar
6	Fuse 32 Interior Lighting
7	Passenger Door Lock
8	Fuse 5 (20A)
9	Audio Speaker L-Rear
10	Audio Speaker L-Rear
11	Not Used
12	Not Used
13	Not Used
14	Right Rear Door Ajar

C11-H Connector



Item	Description
1	Fuse 52 (Modified Vehicle Wiring) VPWR (40A) Run/Start Fused Feed
2	Upfitter Customer Access Pass Thru_1
3	Upfitter Customer Access Pass Thru_2
4	Fuse 53 (Modified Vehicle Wiring) VBATT (40A)

4.18.4 Customer Connection Points



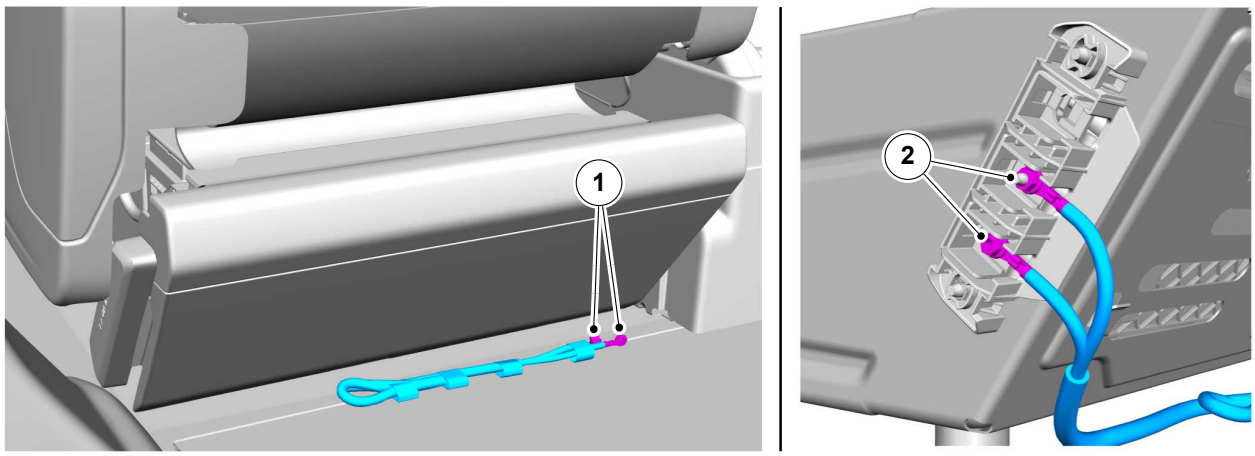
E192338

Item	Description
A	Customer Connection Point Cover
F12 - F14	60A Fuse
C1 - C3	Customer Connection Point

WARNING: If additional loads or connections are required, make sure that the correct level of base vehicle is ordered.

1x 60A fuse is fitted in the Customer Connection Point as standard. 3x 60A fuses are fitted in the Customer Connection Points supplied as part of the Auxiliary Switch Pack.

NOTE: For vehicles with Upgraded Auxiliary Fuse Panel: two 60A fuses from the Customer Connection Points will be required to power two 40A fuses in the Fuse Box. For further information see Fuse Box table in this section. The two 40A supplies are not connected at the assembly line. The power supply is stowed under the carpet behind the drivers seat pedestal which the upfitter is required to connect to the Customer Connection Points, see figure E233938.



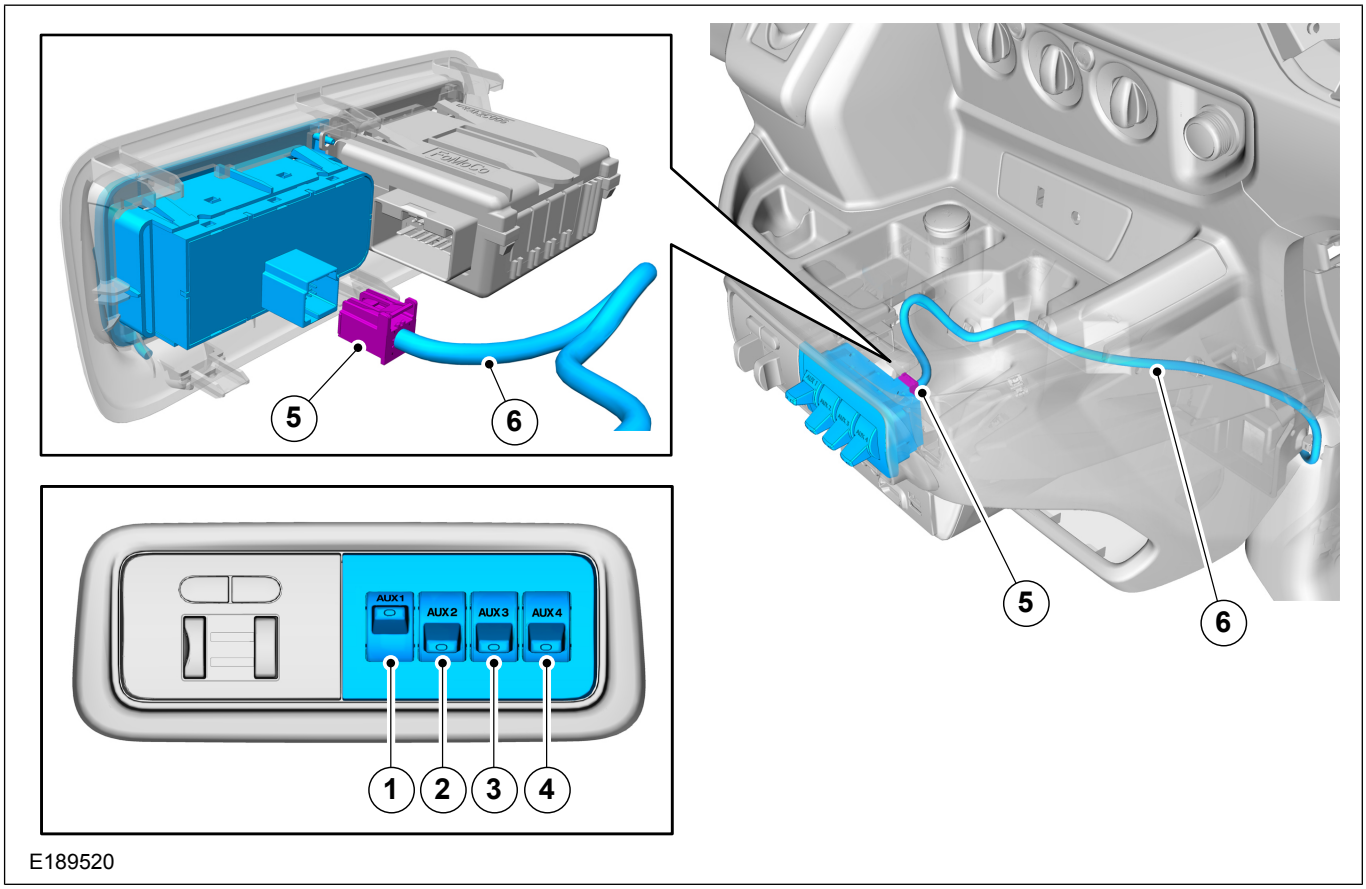
E233938

If the switches are not required but additional loads, connections and signals are still needed, it is necessary to order the Modified Vehicle Wiring System on the base vehicle.

For power and connectivity usage recommendations

Refer to: 4.4 Battery and Cables (page 72).

4.18.5 Auxiliary Switches - Vehicles Built before June 2016



E189520

Item	Description	Item	Description
1	Aux 1	4	Aux 4
2	Aux 2	5	Auxiliary Switch Pack Connector
3	Aux 3	6	14401 Harness

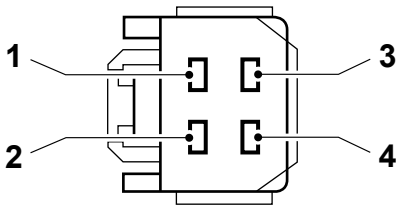
When the switches are pressed (light on) the switches provide a +12V/20A output.

NOTE: Auxiliary Switches are Ignition supplied.

Auxiliary switch output is found in Connector C33-H under the driver's seat, shown in Figure E189517

If heavy loads are required, controlled via these switches (especially at engine off) it is recommended to order High Performance Deep Cycle AGM batteries on the base vehicle. The switches are illuminated red when the lights are: side, dipped, full beam or auto lights on. They switch +12V and switch a 20A relay with 20A relay output fuse.

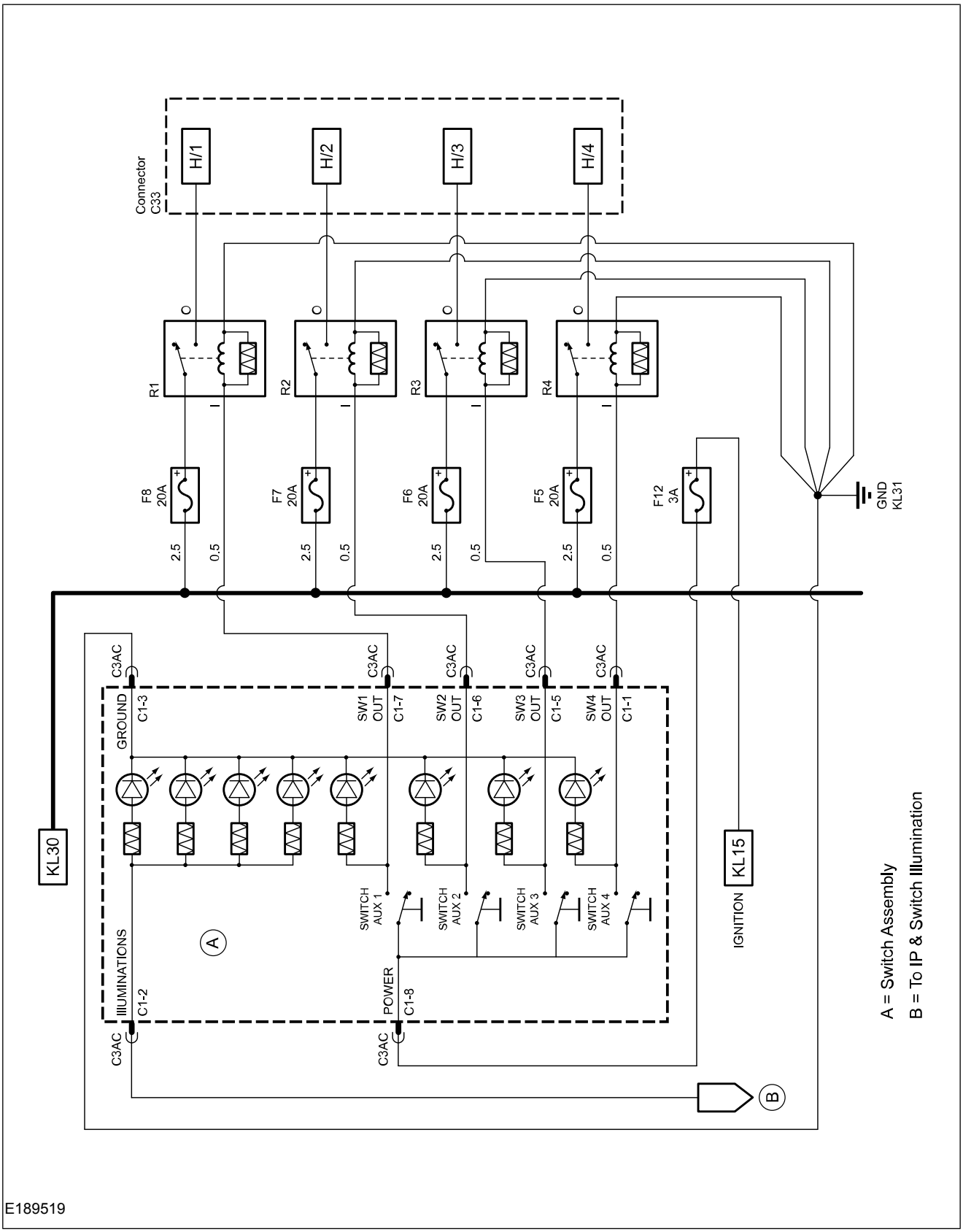
Auxiliary SW Output - C33-H



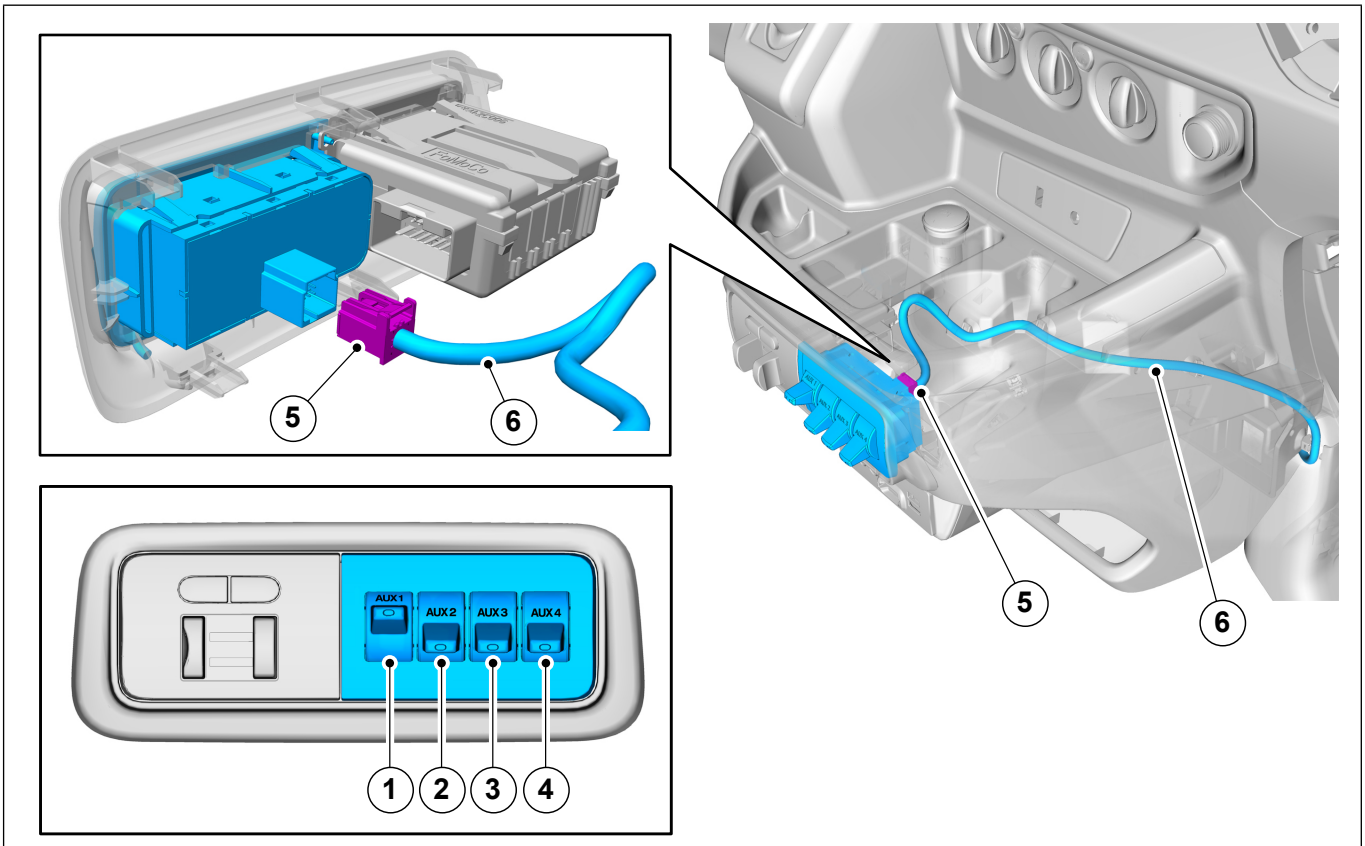
E190474

Item	Description
1	R1 Auxiliary Fuse Box Auxiliary Switch 1 Out
2	R2 Auxiliary Fuse Box Auxiliary Switch 2 Out
3	R3 Auxiliary Fuse Box Auxiliary Switch 3 Out
4	R4 Auxiliary Fuse Box Auxiliary Switch 4 Out

Auxiliary Fuse Panel Circuit Diagram



4.18.6 High Capacity Auxiliary Switches - Vehicles Built After June 2016



E189520

Item	Description	Current (A)	Comments
1	Aux 1	20	Ignition supplied/Hot at all times
2	Aux 2	20	Ignition supplied/Hot at all times
3	Aux 3	40	Ignition supplied/Hot at all times
4	Aux 4	40	Engine Run
-	Unswitched	20	Ignition Supplied
-	Unswitched	20	Ignition Supplied
5	Auxiliary Switch Pack Connector		
6	14401 Harness		

When the switches are pressed (light on) the switches provide a +12V(20A,20A,40A,40A) output.

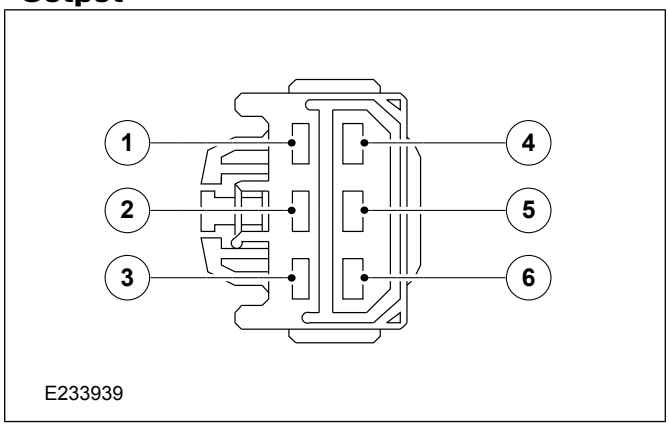
NOTE: Aux 1, 2 and 3 switches are Ignition supplied and Aux 4 is Engine Run.

The Aux 1, 2 and Unswitched power outputs (with respective grounds) are located in High Specification Vehicle Interface Connector, see figure E236206 and table. Aux 3 and Aux 4 power outputs (with respective grounds) are located in the C33-H connector behind the glove box, see figure E233939.

If heavy loads are required, controlled via these switches (especially at engine off) it is recommended to order High Performance Deep Cycle AGM batteries on the base vehicle. The switches are illuminated red when the lights are: side, dipped, full beam or auto lights on.

When the relay (R6) in figure E189518 is exchanged with the 2 pin relay bridge, the Aux 1, 2 and 3 switches will turn to hot/live at all times. The 2 pin relay bridge is available in the accessory kit bag, to use with the Upgraded Auxiliary Fuse Panel option, which can be ordered and supplied with the vehicle at production (depending on vehicle specification) or can be ordered from your local Ford dealer. The LED functionality will indicate switch output condition only during Ignition On and Engine Run. With no ignition state the switch will function and give +12V output but this will not be indicated on the switch LED.

C33-H - High Capacity Auxiliary Switch Output

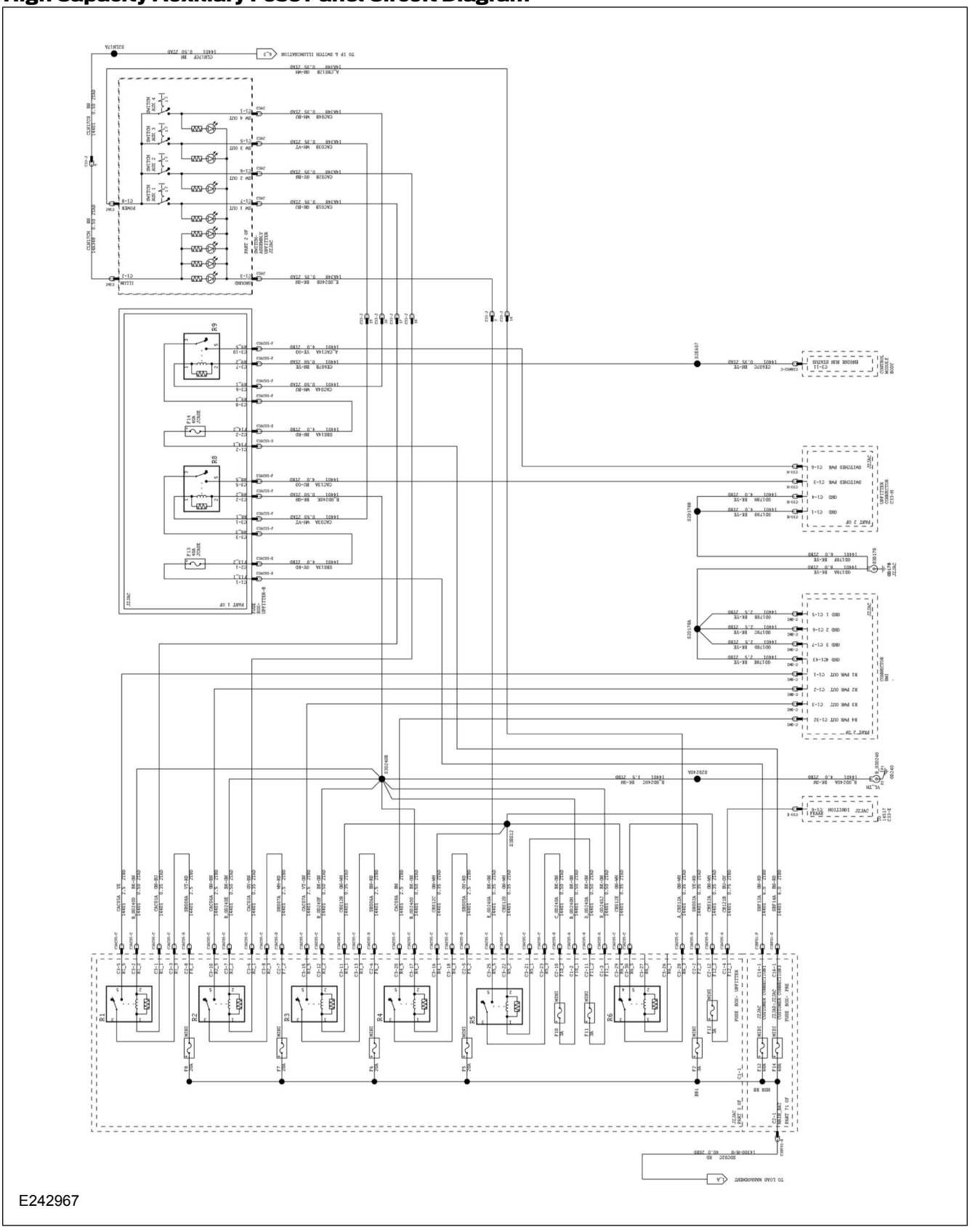


Pin	Description	Comments	Fuse Number	Fuse Rating	Nominal Rating
1	Ground KL31 (40A max)	-	-	-	-
2	Not to be Used	For EMC	-	-	-
3	Upfitter switch 3 Output (40A max, Ignition Supplied)	for EMC reasons, use Ground Pin 1 in this connector	13	40A	32A
4	Ground	-	-	-	-
5	Not to be Used	For EMC	-	-	-
6	Upfitter switch 4 Output (40A max, Ignition Supplied)	for EMC reasons, use Ground pin 4 in this connector	14	40A	32A

Recommendations: When the switches are configured to hot/live at all times please note the following:

- The peripherals to be controlled by the hot/live at all times switches should be visual/audible systems, such as Beacons, Spotlights
- Covert systems such as Water Heaters and Invertors must be fed from Ignition and Engine Run supplies
- If a system is connected to hot at all times which cannot be detected, visually/audibly, then there is a risk of complete battery discharge and therefore failed start

High Capacity Auxiliary Fuse Panel Circuit Diagram



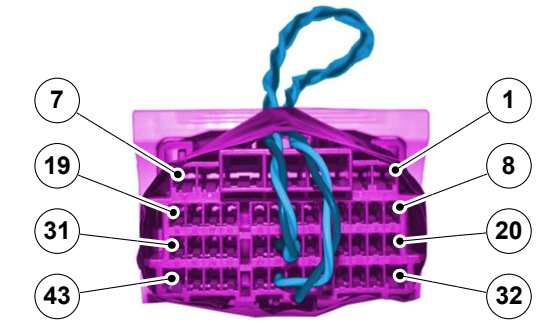
E242967

4.18.7 High Specification Vehicle Interface Connector

The standard system includes the High Capacity Auxiliary Fuse Panel and a Auxiliary Fuse Box, it is powered by two fuses from the Customer Connection Points at the driver's seat pedestal. The Ford production fit location of these feeds are under the carpet at the rear of the drivers seat pedestal and they need to be installed by the modifier as shown in figure E233938. Therefore on high-specification vehicles there will only be one remaining customer connection point available for customer to use.

The High Specification Vehicle Interface Connector (43 way connector), see E236206, is an order only option for production fit and can not be updated after the vehicle is built. The connector is located behind the glove box as shown in E233940. It provides access to multiple signals, power and ground. These signals include those required for Police/Emergency Service modifications.

A standard mating connector, with a CAN loop wire between cavities 25-26 and 37-38 is provide (no other wires). For further information see 125kb/s MS CAN Access Interface in this section.



E236206

High Specification Vehicle Interface Connector

Cavity	Wire	Signal	Comments	Fuse	Fuse Rating	Nominal Rating
1	2.50	Upfitter switch 1 Output (20A max, Ignition Supplied)	For EMC reasons, use Grounds in this connector	8	20A	16A
2	2.50	Upfitter switch 2 Output (20A max, Ignition Supplied)	For EMC reasons, use Grounds in this connector	7	20A	16A
3	2.50	Unswitched Upfitter Output (20A max, Ignition Supplied)	For EMC reasons, use Grounds in this connector	6	20A	16A
4	-	-	-	-	-	-
5	2.50	KL31-20A max.	Ground	-	-	
6	2.50	KL31-20A max.	Ground	-	-	-
7	2.50	KL30	Battery Supply	-	-	-
8	-	Turn Signal Left	Low Power: Only to be used to drive relay coil	-	-	-
9	-	Turn Signal Right	Low Power: Only to be used to drive relay coil	-	-	-
10	-	IP+Switch Illumination	PWM Signal from BCM	-	-	-
11	-	Stop Lamp Signal (CHMSL)	PWM Signal from BCM	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	LHS Sliding Door Ajar	Door Open = Ground (<50 ohms)	10	5A	4A
17	-	Passenger Door Ajar	Door Closed = Ground(<50 ohms)	11	10A	8A
18	-	Drivers Door Ajar	Door Closed = Ground(<50 ohms)	12	5A	4A
19	-	Cargo Door Ajar	Door Open (<50 ohms)	-	-	-
20	-	High Beam Signal	Output from BCM	-	-	-
21	-	Low Beam Signal	Output from BCM	-	-	-
22	-	Parking/Marker Lights	PWM Signal from BCM	-	-	-
23	-	Horn Signal	Relay Coil Switched Ground (by BCM)	-	-	-
24	0.50	-	-	-	-	-
25	-	MS-CAN High OUT	Bridged via circuit on mating connector to ensure CAN functionality. If mating connector removed, CAN disruption			-
26	-	MS-CAN High IN		-	-	-
27	-	-	-	-	-	-
28	-	-	-	-	-	-
29	-	Engine Run	Engine Running = Ground (<50 ohms)	-	-	-
30	-	Park Brake Signal	Park Brake Engaged = Ground (<50 ohms)	-	-	-
31	-	RHS Sliding Door Ajar	Door Open = Ground (<50 ohms)	-	-	-
32	2.5	Unswitched Upfitter Output (20A max, Ignition Supplied)	For EMC reasons, use Grounds in this connector	5	20A	16A
33	-	Reverse Signal	PWM Signal from BCM	-	-	-
34	-	Vehicle speed	to be used as input to ECU's only	-	-	-
35	-	-	Output from BCM	-	-	-
36	-	-	-	-	-	-
37	-	MS CAN Low OUT	Bridged via circuit on mating connector to ensure CAN functionality. If mating connector removed, CAN disruption	-	-	-
38	-	MS CAN Low IN		-	-	-
39	-	-	-	-	-	-
40	-	-	-	-	-	-

Cavity	Wire	Signal	Comments	Fuse	Fuse Rating	Nominal Rating
41	-	Lock Request	+12V 500ms. Ground (<50 ohms) all other times	-	-	-
42	-	Unlock Request	+12V 500ms. Ground (<50 ohms) all other times	-	-	-
43	2.50	Ground KL31 (20A max)	-	-	-	-

WARNINGS:

The fuse ratings and nominal ratings within the table should be followed strictly. Any deviation could insecurely interfere with the validated fusing strategy and wiring architecture. Some inputs are provided via electronic modules and any overloading could cause serious vehicle malfunction and may conflict with legal requirements.

No increase in existing vehicle standard fuse capacity is allowed under any circumstances.

On high-spec vehicles the C1 connector is not available as a customer interface and only the 43 way connector should be used. The connector to add wiring for switches and beacons is still available.

Accessory Kits - Vehicles Built After Mid August 2016 (2017MY)

There are 2 separate accessory kit bags available to be ordered for use with the Upgraded Auxiliary Fuse Panel option, both kits can be ordered and supplied with the vehicle as production fit or from your local Ford dealer (depending on the vehicle specification). Accessory Kit Bag 1 is for vehicle ordered with Upgraded Auxiliary Fuse Panel **less** Trailer Brake Module and Accessory Kit Bag 2 is for vehicle ordered with Upgraded Auxiliary Fuse Panel **with** Trailer Brake Module.

Accessory Kit Bag 1:

- 43 Way Jumper Lead consists of a mating connector and 40" (1m) of wiring for the High Specification Vehicle Interface Connector
- 6 Way Jumper Lead consists of a mating connector and 27.5" (0.7m) of wiring for the C33H High Capacity Auxiliary Switch Output Connector

- 21 Way Jumper Lead with 7 circuits consists of a mating connector and 27.5" (0.7m) of wiring for the 21 way inline connector. The 21 way inline connector is located behind the lower center console trim, see E244856. Refer to Workshop Manual 501-12 Instrument Panel and Console Removal and Installation or contact your local Ford dealer for access to the inline connector. The 21 way jumper lead with 7 circuits must be used when the vehicle is ordered with Upgraded Auxiliary Fuse Panel less Trailer Brake Module and less High Capacity Auxiliary Switches option. This allows the upfitters to have their own third party switches
- 2 Pin Relay Bridge – For vehicles ordered with Upgraded Auxiliary Fuse Panel with Switches - when the 2 pin relay bridge is fitted instead of the relay R6 (see figure E189518) the Aux Switches 1, 2 and 3 will turn from Ignition fed to Hot/Live at all times. For vehicles ordered with Upgraded Auxiliary Fuse Panel less Switches - when the 2 pin relay bridge is fitted instead of the relay R6 the 20A outputs (see figure E236206 - High Specification Connector Pin 1 and Pin 2) and the 40A output (see figure E233939 - C33-H Connector, Pin 1) will turn to hot/live at all times when fitted with third party switches

Accessory Kit Bag 2:

- 43 Way Jumper Lead consists of a mating connector and 40" (1m) of wiring for the High Specification Vehicle Interface Connector
- 6 Way Jumper Lead consists of a mating connector and 27.5" (0.7m) of wiring for the C33H High Capacity Auxiliary Switch Output Connector.
- 21 Way Jumper Lead with 16 circuits consists of a mating connector and two 27.5" (0.7m) of wiring, one wiring with open ended circuits (heat shrink) for the third party switches and the other wiring and connector for the Trailer Brake Module for the 21 Way inline connector. The 21 way inline connector is located behind the lower center console trim, see E244856. Refer to Workshop Manual 501-12 Instrument Panel and Console Removal and Installation or contact your local Ford dealer for access to the inline connector. The 21 way jumper lead with 16 circuits must be used when the vehicle is ordered with Upgraded Auxiliary Fuse Panel with Trailer Brake Module and less High Capacity Auxiliary Switches option
- 2 Pin Relay Bridge – For vehicles ordered with Upgraded Auxiliary Fuse Panel with Switches - when the 2 pin relay bridge is fitted instead of the relay R6 (see figure E189518) the Aux Switches 1, 2 and 3 will turn from Ignition fed to Hot/Live at all times. For vehicles ordered with Upgraded Auxiliary Fuse Panel less Switches - when the 2 pin relay bridge is fitted instead of the relay R6 it will turn the 20A outputs (see figure E236206 - High Specification Connector Pin 1 and Pin 2) and the 40A output (see figure E233939 - C33-H Connector, Pin 1) to hot/live at all times when fitted with third party switches

125kb/s MS CAN Access Interface

WARNING: It is not allowed to transmit DATA on any of the CAN lines. The system provided to splice into the 125kb/s MS CAN Bus is for modules that will read only. If messages are transmitted from a third party fit module, vehicle functionality can be compromised and lead to serious failure. It is vital that any CAN stubs added must comply to the twisted rate, length, correct parity, with routing away from any high EMP devices.

NOTE: Please contact your local Ford Dealer for availability.

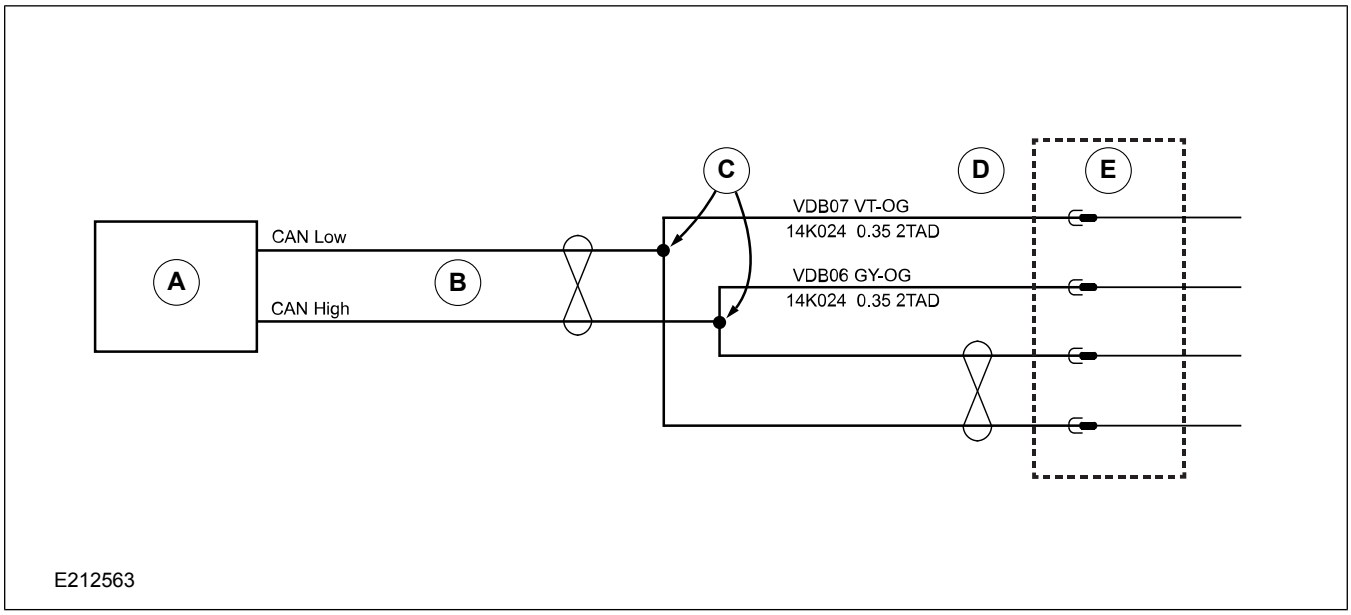
The High Specification Interface Connector option has a 125Kb/s MS CAN interface EDS connection point that can have third party CAN wires spliced into. This is designed to provide Ford CAN Bus interfacing for third party fit module telematics and logic controller systems. For further information on splicing

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).

Modules to be installed are only allowed to be read ONLY of the Ford system CAN Bus data and must be CE marked. After installation, functional testing of Ford systems connected to the same CAN Bus is expected. These include Trailer Tow, Rear Camera, Body Control Systems, Fuel Fired Heater and Cluster Systems. The system should also receive a health check DTC read to ensure no failures are present after the installation and ignition cycle has been performed. The converter is also responsible for legal compliance to EU EMC requirements of the finished system and ensure no adverse impact has been generated to the existing Ford systems. Please refer to Section 1 of the BEMM for responsibility and EMC compliance.

The CAN Interface loop wire, see figure E236206, is located in the 43 WAY interface connector, behind the glove box and outboard to the wheel arch. The half way loop point can be spliced into with third party twisted pairs of at least 3 twists per 1.96" (50mm) and a minimum of 11.8"(0.3m) to a maximum of 78.7" (2m) stub length to module. CAN Low is the Gray/Orange wire. CAN High is the Violet/Orange wire.

Third Party Fit CAN Read Module



Item	Description
A	Modifier Fit Read Module
B	Modifier Fit Stub Wiring
C	Spliced Interface Connection
D	Ford CAN Loop Wire - CAN High is the Gray/Orange wire. CAN Low is the Violet/Orange wire
E	Hi Spec

Can bus network stubs must comply with the following standards:

- Originate a the CAN bus backbone.
- Have a final length of between 11.8" (0.3m) and 78.7" (2m), see dimension 'X' in figure E212566
- Have at least 3 twists per 1.96" (50mm) of wire
- follow the splice guidelines, shown later in this section

Stub length added must exceed 11.8" (0.3m) but be less than 78.7" (2m), at least 3 twists per 1.96" (50mm) of wire and not be less than 1.96" (50mm) of untwisted wire to the added module or splice.

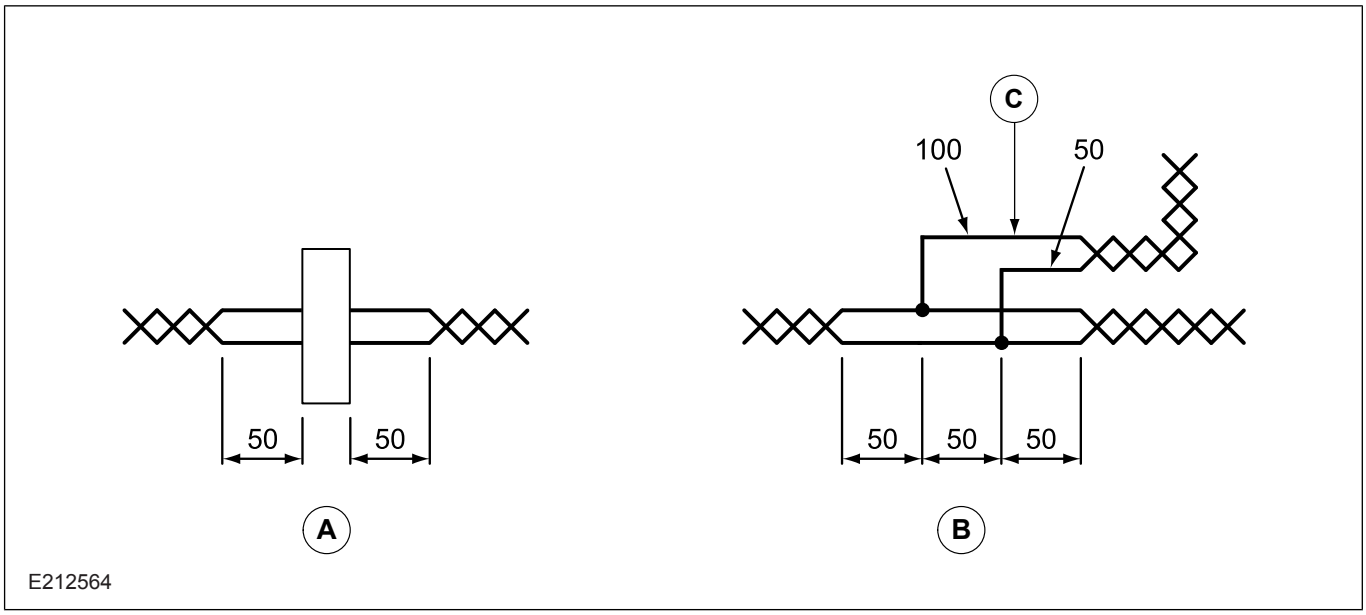
Physical Interface of spliced in EDS Requirements

Parameter	Minimum	Nominal	Maximum	Units
Impedance	108	120	132	Ohm
Resistance	-	-	175	milli Ohm/meter
Signal Speed	-	-	5.5	nano Second/ meter
Twisting	3[(1)]	-	-	Twisted/1.96" (50mm)
Phase Shift	-	-	3.4	nano Second
Differential Mode Offset	-	-	0.5	Volts

[(1)]= The Twisted circuits shall have a minimum twist rate of 3 twists (4 wire crossovers) per 1.96" (50mm). One "twist" or "turn" = 180 deg. Rotation. Twisting shall be maintained to within 1.96" (50mm) of any in-line or component connector.

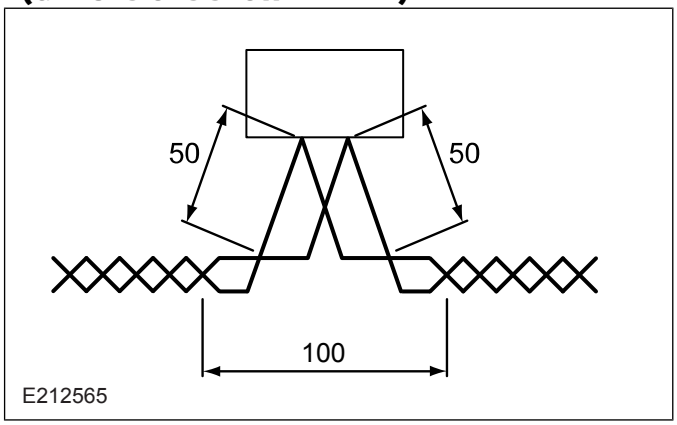
The twisted pair that forms the CAN Bus shall be twisted throughout the total run of the vehicle except for a maximum of 1.96" (50mm) from connectors or harness splices. At splices an additional 1.96" (50mm) of untwisted wire is allowed between the CAN H and CAN L contact points.

Twisted Circuits - all values are maximum limits (dimensions shown in mm)



Item	Description
A	Connector
B	Splice
C	Typically taped to backbone

Maximum CAN Bus Length Series Chain Method - all values are maximum limits (dimensions shown in mm)



It is allowed to connect modules to the backbone using a series chain method instead of a stub. If the series chain method is selected, the untwisted wire on each side of the double crimp in the connector cannot exceed 1.96" (50mm). See figure E212565

The two terminating ECU's shall be placed the 'furthest' distance apart on the CAN Bus. The maximum wiring length for each type of network is defined in the following table

Maximum CAN Network Lengths

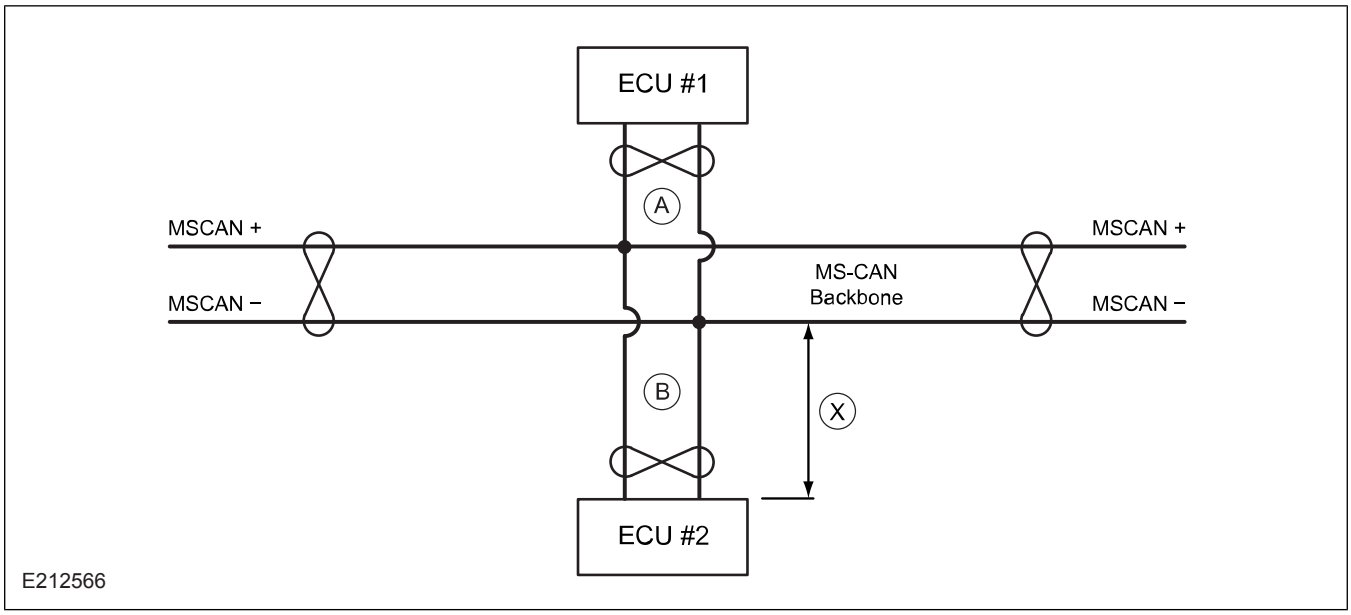
Network Speed	Between terminating ECU's	SAE J1962 Connector to 'Furthest' Terminating ECU[1]
125 kbps	1968.5" (50m)	1771.6" (45m)
500 kbps	1318.9" (33.5m)	1122.0" (28.5m)

[1] = This allows for an off-board tester cable of up to 196.8" (5m).

NOTE: Exceeding the permitted CAN network lengths will result in data transfer issues and could cause serious vehicle error.

Cable Stub Length: Must be a final length of between 11.8" (0.3m) and 78.7" (2m), see dimension 'X' in figure E212566. It is acceptable for any stub, except the terminating ECU stubs, to be open circuit and unterminated, i.e. harness variants are not required to support option fit ECU's.

Cable Stud Circuit



Item	Description
A	Stub 1
B	Stub 2
X	Stub - Final length between 11.8" (0.3m) and 78.7" (2m)

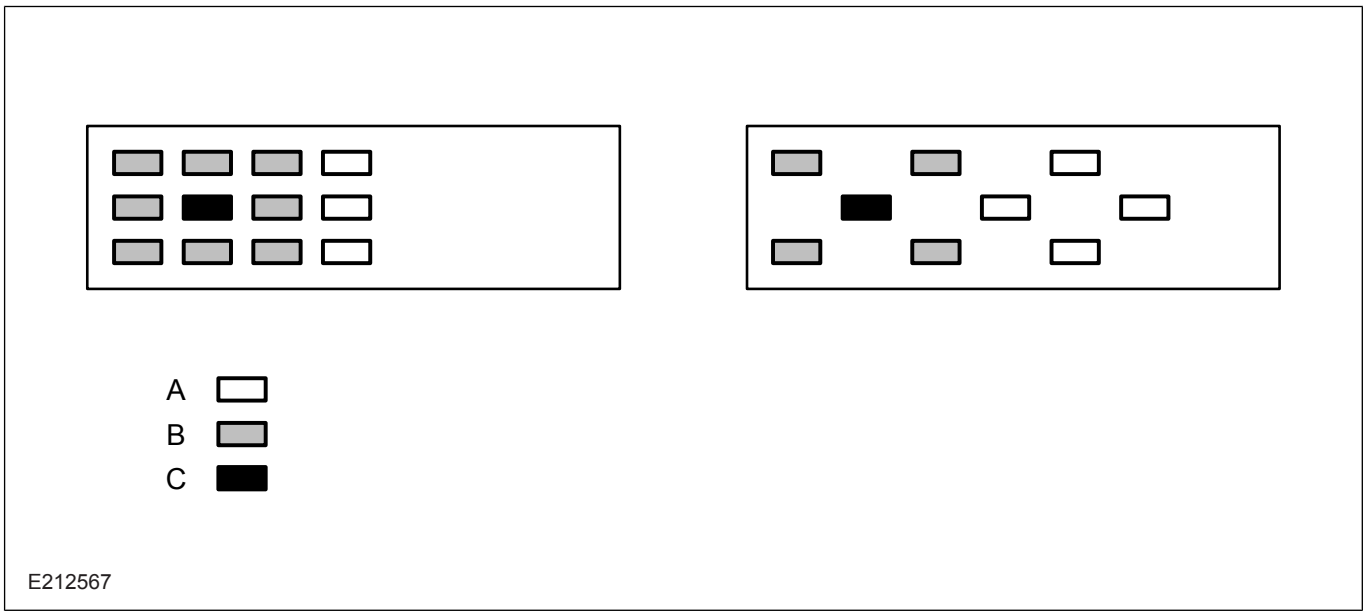
Stub Splices: The general rule is that there shall be at least 1.96" (50mm) of twisted wire between any series of the following connections: splice – splice, connector - splice, connector - connector, Splices include wire to wire splices and splice blocks.

Two stubs may be connected to the same stub connection point at the CAN backbone only on a 125 kb/s (MSCAN) bus. In this case the stubs must differ in length by at least 10%. Example: If one stub is 39.4" (1m) long the second can be less than 35.4" (0.9m) or between 43.3" (1.1m) and 78.7" (2m).

Stud Topologies: Stubs connected to stubs are not allowed. If multiple nodes need to be connected to a single stub then the nodes must be series chained. This can be accomplished by double crimping if only two pins (CAN H & CAN L) are available or making the CAN Bus connection through the module if four pins are available (2 x CAN H & 2 x CAN L).

The maximum number of ECU's on network transmission speed 125 kb/s, including the off-board tester, is 32.

The two wires forming each pair of CAN H and CAN L connections shall be routed via physically adjacent pins as shown in the figure E212567.



Item	Description
A	Non Adjacent Pins
B	Adjacent Pins
C	CAN H or CAN L

Each Bus pair may be routed via separate connectors.

Details of the pin allocation for each node shall be defined in the relevant module specification

The voltage supply used by the network interface must not be directly connected to any external part. That means that the regulated power used by the CAN-circuitry on the printed circuit board shall be used only inside the cover of the ECU. Note: this does not apply to the Vbat connection required for full-sleep functionality in transceivers powered by Vbat.

The CAN network shall be fully functional, as a minimum, over the operating range 9V to 16V, as measured at the modules battery pin. Outside this operating range, it is recommended that modules continue to communicate. However, it is not acceptable for modules to send corrupt messages/error frames/illegal symbols, or disrupt the transmissions of other modules.

NOTE: Module feature requirements may require a larger operating range

Modules shall not drive the CAN bus dominant during module reset.

Common mode EMC chokes shall not be used in terminating nodes. Additionally chokes may only be used in non-terminating ECU's with the agreement of the relevant FMC design authority, for each vehicle program to which the ECU shall be fitted.

Suppliers may Electrostatic Component Discharge components as long as pass tests:

- Conducted Immunity
  - CI 280 Electrostatic Discharge
  - CI 270-C Immunity to Voltage Overstress (24V), applied to CAN H and CAN L

Additionally, the capacitance of the component, measured at 2.5V reverse bias, shall be <30pF

The zener stacks may be removed for modules on CAN links that do not connect to the diagnostic connector as long as it is shown that the unpowered ESD test can be passed without these parts (Powered ESD testing on the CAN pins is not required for modules that do not connect to the diagnostic connector). The circuit board pads for these parts must be present for all designs.

All grounding of the CAN transceiver and capacitors shall be made to ECU signal ground.

All transceiver voltage reference pins shall be left open circuit.

Capacitors shall be monolithic ceramic capacitors or equivalent.

A ground plane is required under the transceiver chip on the component layer of the PCB.

Transceiver shall be located as close to edge connector as possible. Other IC's are not permitted between edge connector and the transceiver

CAN H / CAN L circuits between edge connector and transceiver shall be as short as possible and routed side-by-side. Guard tracks are required for all CAN H / CAN L, TXD and RXD circuits on the same PCB layer. Guard tracks should not be placed between CAN H and CAN L

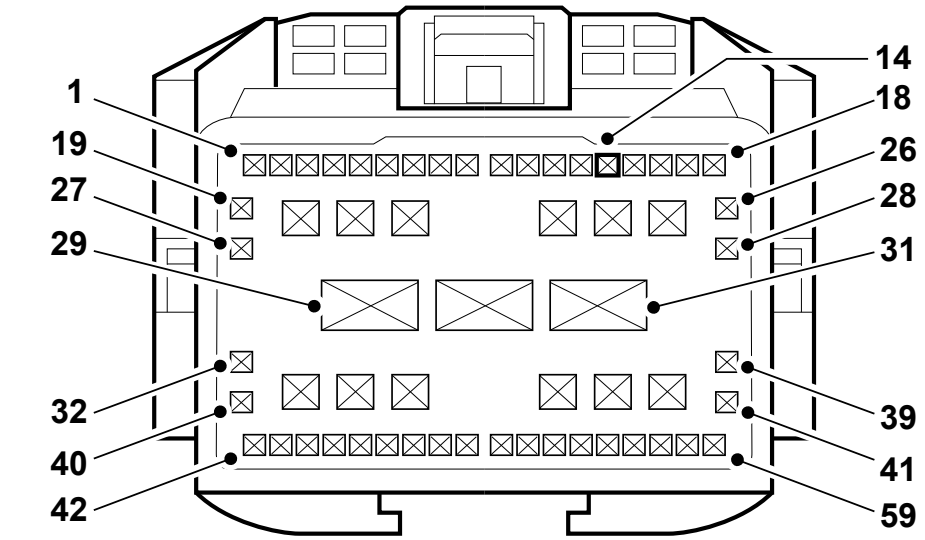
All guard tracks shall be at least 0.02" (0.5mm) wide and grounded at least every 0.39" (10mm).

The decoupling capacitor shall be placed as close as possible to the transceiver.

Transceivers that are battery powered are required to have a Flexisafe capacitor.

4.18.8 Adding Connectors

Marker Lights



Item	Description
Pin 14	Side Marker Supply - Yellow/Violet

WARNING: The Position Marker and Dipped Beam Lights of the vehicle are collectively powered via F11 and F15 in the Body Control Module at a rating of 25A. A nominal current rating of 20A (full load including all potentially fitted additional lights) must not be exceeded.

- F11 - Dipped Right and Position Left
- F15 - Dipped Left and Position Right

Unused Connectors

The harnesses may have a number of unused connectors – these are dedicated to other features and options, but are **not** always present depending on level of harness fitted. Ford **do not** recommend the use of these connectors for any other purpose than that intended by design.

Power Outlet / Cigar Lighter

Both features adopt a 20A fusing strategy. With a single battery system, continued loading of these features will lead to battery drain, and risk vehicle starting. If continuous power is required, a second battery option should be installed and the customer connection points, where fitted, utilized. At engine OFF, all three power outlets are connected to the battery saver system, where the supply will switch off at 30 minutes.

4.19 Grounding

4.19.1 Ground Points

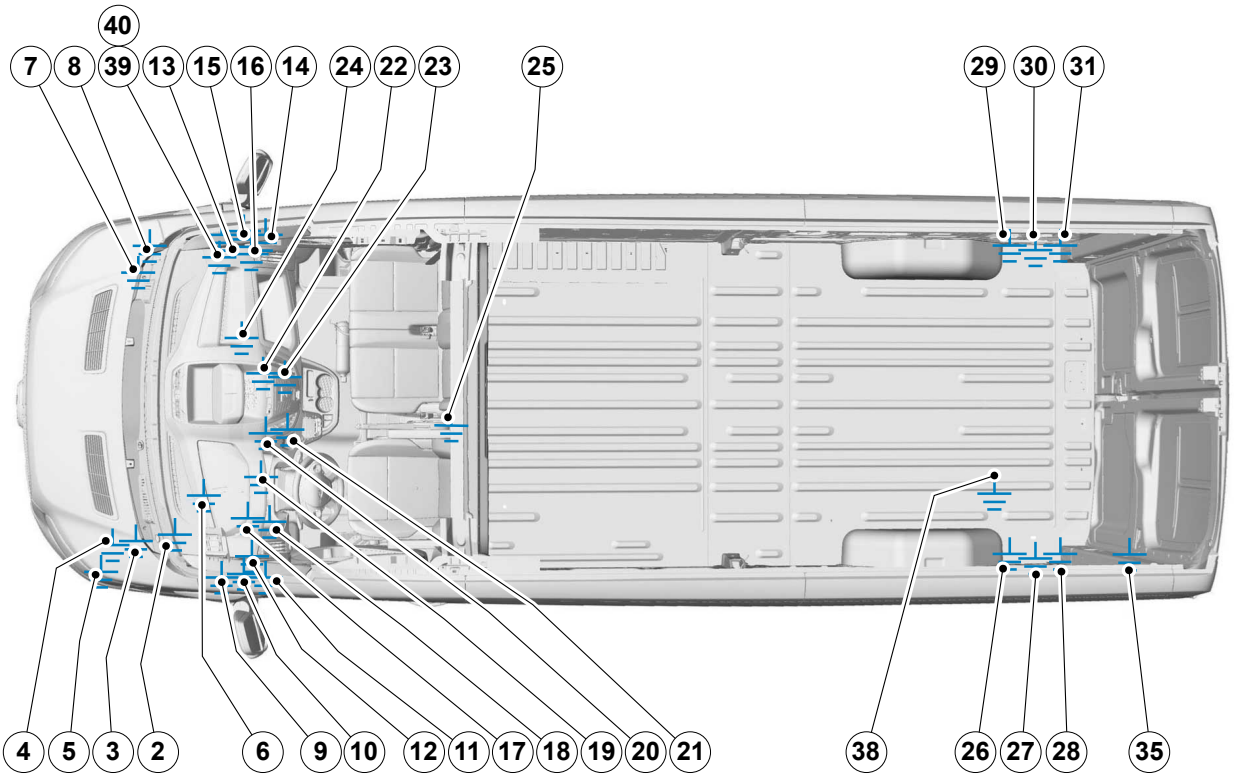
CAUTIONS:

Only use the ground points indicated. Using alternative points may affect the vehicle integrity.

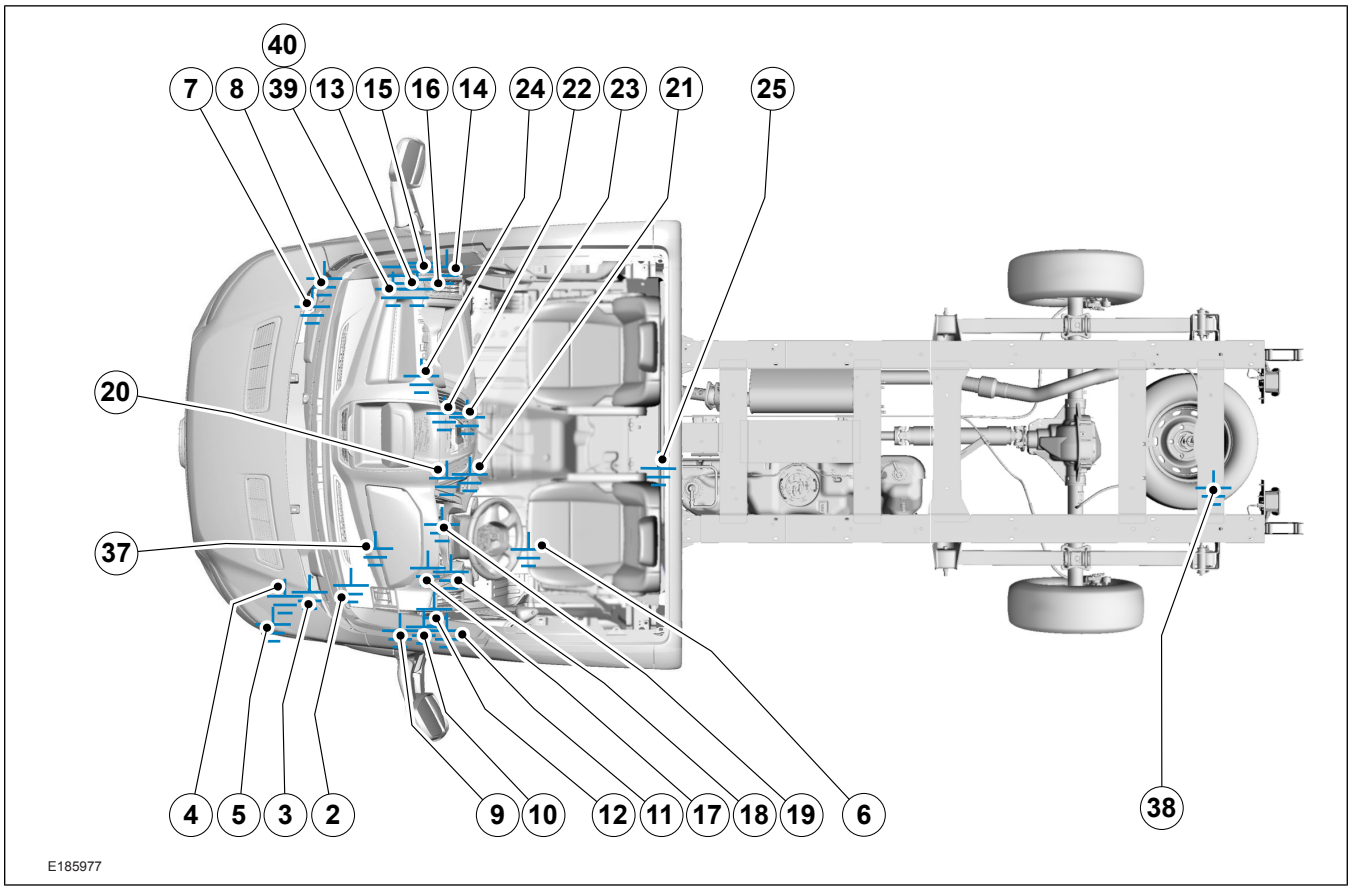
Make sure that all ground points are tightened to the correct torque.

Ground wires should be brought back to the Ford ground points provided, please refer to the following figures.

Van, Wagon Ground Points



Chassis Cab Ground Points

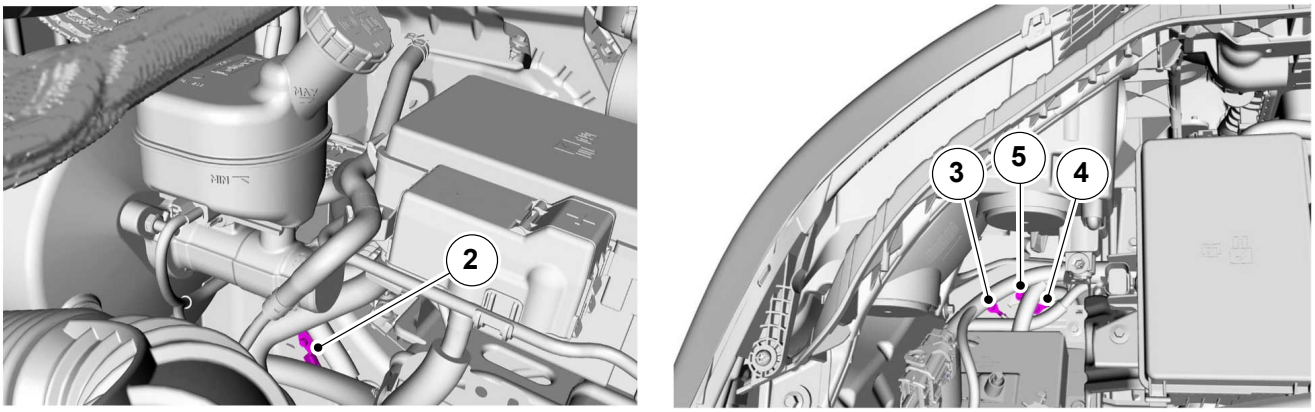


Ground Point	Location	Type	Harness
Ground Points - Chassis Cabs and Van, Bus, Kombi			
GP2	Engine Bay LHS	Misc Power Electric	14401
GP3	Engine Bay LHS	Exhaust Emissions Control	9K499
GP4	Engine Bay LHS	Exhaust Emissions Control	9K499
GP5	Engine Bay LHS	Exhaust Emissions Control	9K499
GP6	Engine Bay LHS	Fuel Tank Sender	14406
GP7	Engine Bay RHS	Misc Power Electric	14401
GP8	Engine Bay RHS	Misc Power Electric	14401
GP9	A Pillar LHS Upper	Misc Power Electric	13A409
GP10	A Pillar LHs Lower	Misc Power Electric	14401
GP11	A Pillar LHS Lower	Rear Air Condition Control	14401
GP12	A Pillar LHS Lower	Misc Power Electric	14401
GP13	A Pillar RHS Upper	Misc Power Electric	14659
GP14	A Pillar RHS Lower	Misc Power Electric	14401
GP15	A Pillar RHS Lower	Misc Power Electric	14K024
GP16	A Pillar RHS Lower	Misc Power Electric	14401
GP17	Cross Car Beam LHS	Misc Power Electric	14K024
GP18	Cross Car Beam LHS	Misc Power Electric	14K024
GP19	Cross Car Beam LHS	Misc Power Electric	14K024
GP20	Cross Car Beam LHS	Misc Power Electric	14K024
GP21	Cross Car Beam LHS	Misc Power Electric	14K024
GP22	Cross Car Beam LHS	Misc Power Electric	14K024
GP23	Cross Car Beam LHS	Misc Power Electric	14K024
GP24	Cross Car Beam RHS	Misc Power Electric	14K024
GP25	Passenger Compartment	Misc Power Electric	14401
GP26	Bodyside Rear LHS	Misc Power Electric	13A409
GP38	Rear Cross Member	Trailer Tow Socket	13B576
GP39	RHS Wheel Arch	Exhaust Emissions Control	14D469
GP40	RHS Wheel Arch	Exhaust Emissions Control	14D469
Ground Points - Van, Wagon Only			
GP27	Bodyside Rear LHS	Misc Power Electric	13A409
GP28	Bodyside Rear LHS	Misc Power Electric	13A409
GP29	Bodyside Rear RHS	Misc Power Electric	13A409
GP30	Bodyside Rear RHS	Misc Power Electric	13A409
GP31	Bodyside Rear RHS	Misc Power Electric	13A409
GP35	D Pillar LHS middle	Misc Power Electric	14659
Ground Points - Chassis Cabs/Cutaways Only			
GP37	Engine Bay LHS	Chassis Cab Lighting	14406

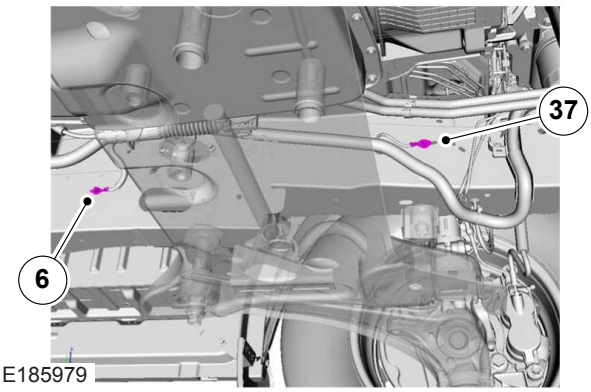
Ford M6 x 1.0, 20mm thread rolling screw - torque 12Nm ± 1.8

Abbreviations used in table: LHS - Left Hand Side, RHS - Right Hand Side, Misc - Miscellaneous.

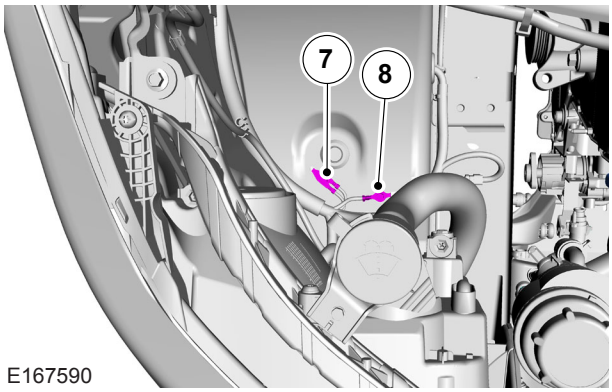
Engine Bay



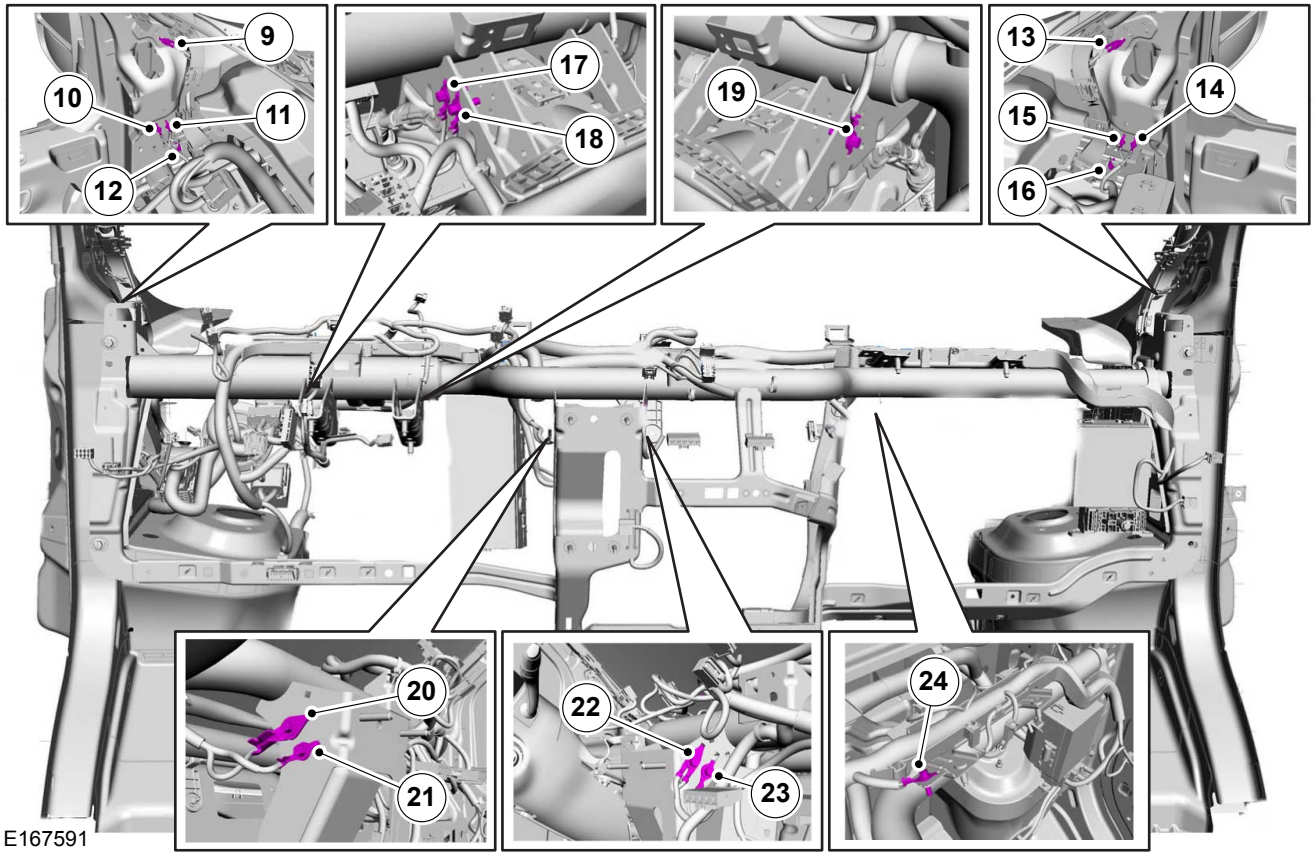
E185978



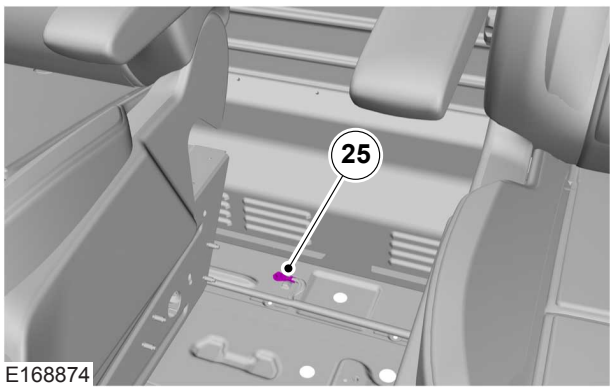
E185979



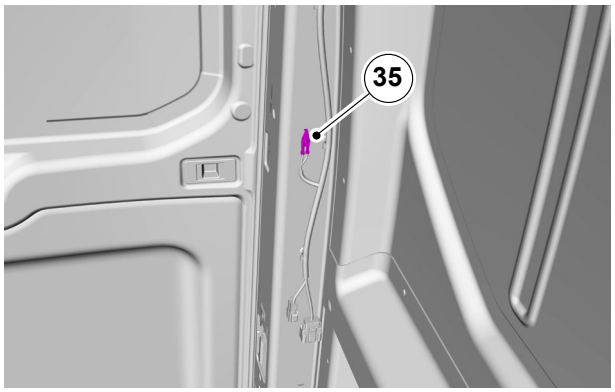
E167590

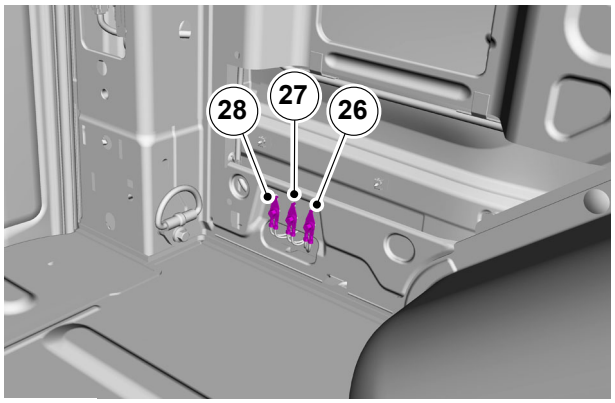


E167591



E168874





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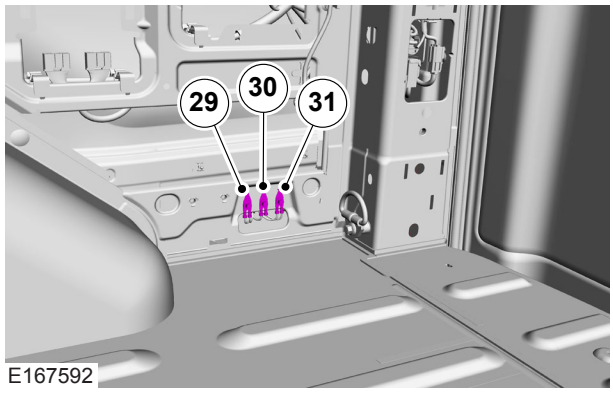
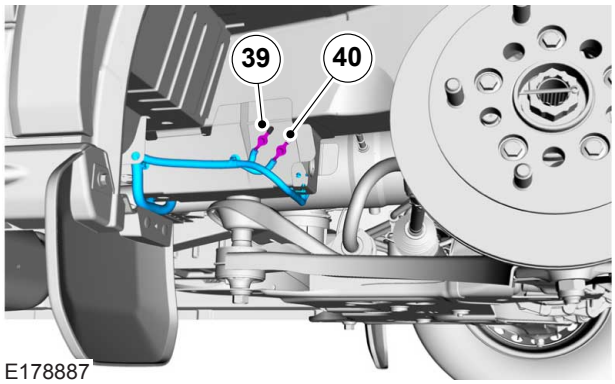


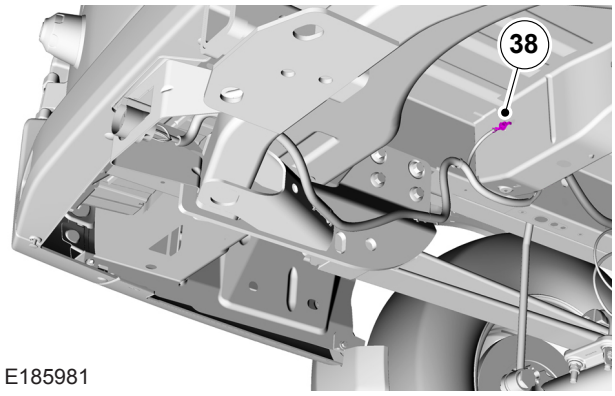
E167592

Right Hand Side Wheel Arch



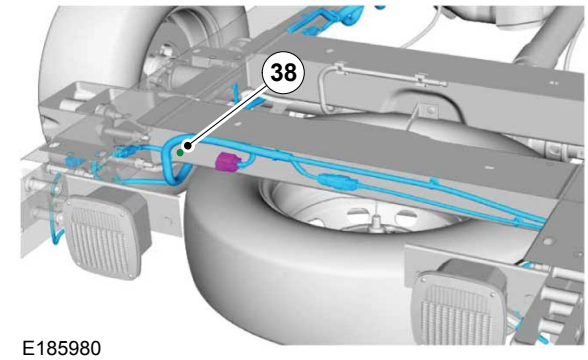
E178887

Trailer Tow Socket - Van/Wagon



E185981

Trailer Tow Socket - Chassis Cab



E185980

5.1.1 Body Structures - General Information

When carrying out vehicle modifications the following points should be considered:

- Make sure that the vehicle structural integrity is maintained
- Do not drill into closed frame body members
- Make sure that the design for the body alterations or additional structure disperse the load evenly

CAUTION: Uneven load distribution could result in unacceptable handling and braking characteristics.

- Re-paint metal edges after cutting or drilling. All metal edges must comply with exterior and interior protection legislation
- All fixings through the floor, sides or roof must be sealed

Ensure proper sealing against ingress of water, salt, dust, after cutting or drilling the body. Use Ford approved sealing and finishing material, and underbody corrosion protection.

Refer to: 5.13 Corrosion Prevention (page 196).

- Make sure that fixings in the 'B' pillar area do not encroach on the seat belts or seat belt reels

For unique floor fixings, see (Frame Drilling and Tube Reinforcing)

Refer to: 5.14 Frame and Body Mounting (page 197).

For Load Compartment Tie Downs (Load Lashing Points)

Refer to: 5.4 Loadspace (page 176).

WARNINGS:

Before drilling see figures E184299 and E185270 for Boron Steel parts, in this section of the manual.

Before drilling the floor around the fuel tank, check the Precautionary Drill Zones, see Figure E185647 and E185269 in this section.

For additional Precautionary Drill Zones

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).
Refer to: 5.5 Body Closures (page 177).

5.1.2 Welding/Plasma Cutting

WARNING: Before Welding see figures E184299 and E185270 for Boron Steel parts, in this section of the manual.

Before welding and plasma cutting work is performed on a vehicle body, all safety measures for the protection of people, modules and electrical components must be observed.

Electronic Components

Increased use of comfort and safety electronics in modern motor vehicles also requires the greatest attention to be paid during body work. Over voltages produced during welding and in alignment work during body shell rectification may cause electronic systems to be damaged. In particular, the safety instructions for performing welding work on vehicles with airbag systems must be adhered to.

NOTE: After disconnecting the power supply and before performing further work, a wait time of up to 15 minutes must be maintained, depending on the vehicle. Work on airbag systems may only be performed by a Ford dealer only.

Pay attention to the following points:

- Disconnect the battery negative clamp and cover the battery terminal
- Disconnect the electrical connector at the airbag control module
- Disconnect: Powertrain Control Module, Cluster, ABS Module, Fuel Tank, Body Control Module, Diesel and SCR Module
- If welding is to be performed directly near a control module, it must be removed beforehand
- Never connect the negative cable of the welder near an airbag or a control module
- Connect the negative cable of the welder close to the location of the weld

Before Welding

Interior surfaces of new bodywork components which will no longer be accessible after installation must be painted beforehand. The welding flanges are treated with a special welding primer. The joint areas are not always accessible from inside later. Therefore, prepare these areas so that no soot is produced by burning paint during welding.

NOTE: In order to ensure that the corrosion protection produced in production is not destroyed, the working area must be kept as small as possible.

NOTE: Do not touch cleaned bare metal any more with the bare hands. The dampness of your hands will corrode the metal.

Procedure:

- Remove the primer or paint/zinc layer in the welding area using a tress wire brush to prevent the formation of soot from the paint
- Thoroughly clean the welding area with a metal cleaning agent and rub dry
- Coat the welding flange with welding primer on all sides and allow to dry

NOTE: The welding primer must only be applied thinly to the spot welding area, to minimize spattering when welding.

The following points must be noted when welding:

- Zinc starts to melt at about 788ºF (420ºC)
- The zinc vaporizes at a temperature of about 1652ºF (900ºC)
- The amount of heating determines the damage to the zinc coating, and therefore to the corrosion protection
- Resistance spot welding is particularly suitable for welding zinc-coated panels, because no widespread warming occurs
- With electrolytically zinc-plated panels there is no need for any special preparation because the zinc coating does not need to be removed

After Welding

During work, body panels are often heated at very high temperatures, which results in the destruction of the corrosion protection.

Working of the affected areas is therefore vital:

- Grind the welded seams flat and clean thoroughly with silicone remover. Dry with a lint-free cloth
- If the join area is accessible from the inside, the transition area to the paint must be abraded for all types of join so that good adhesion of the primer is achieved later
- If the join area is not accessible from the inside, the cleaning and sanding work is not done. For this reason, ensure that there is as little contamination as possible in the area of the repair. This allows the cavity wax applied later to penetrate the join area without hindrance

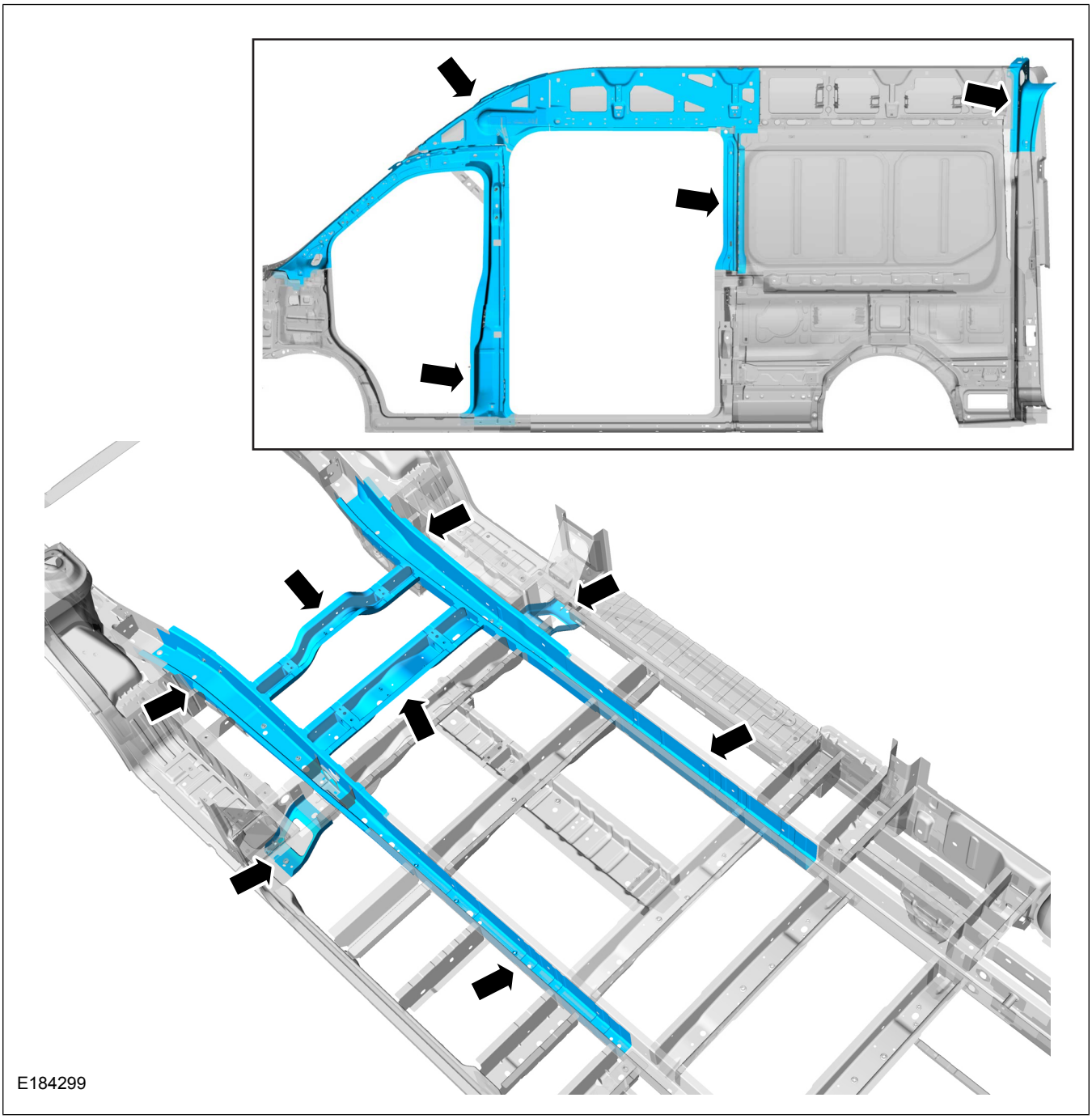
NOTE: Only apply a small amount of panel cleaner to the cleaning cloth when cleaning the area. Make sure that no cleaner reaches the connecting flange, so that the welding primer is not washed away again.

Priming after welding

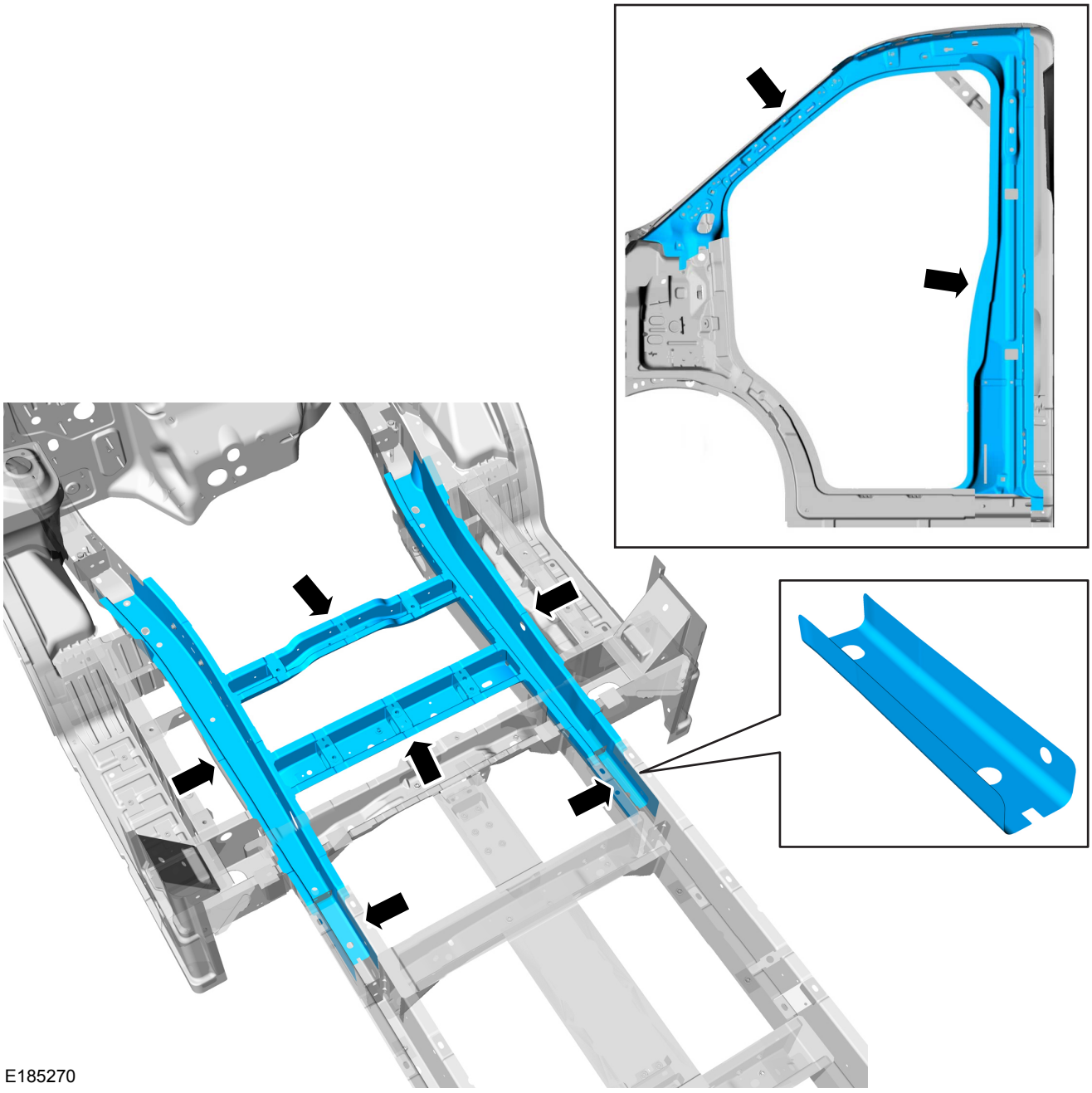
Primer is applied to the welded flanges after cleaning. A check must also be made that the production corrosion protection is present in the area of the flanges. Any damage must also be re-primed

5.1.3 Boron Steel Parts

Boron Steel Parts Van/Wagon - Precautionary Drill or Weld Zones



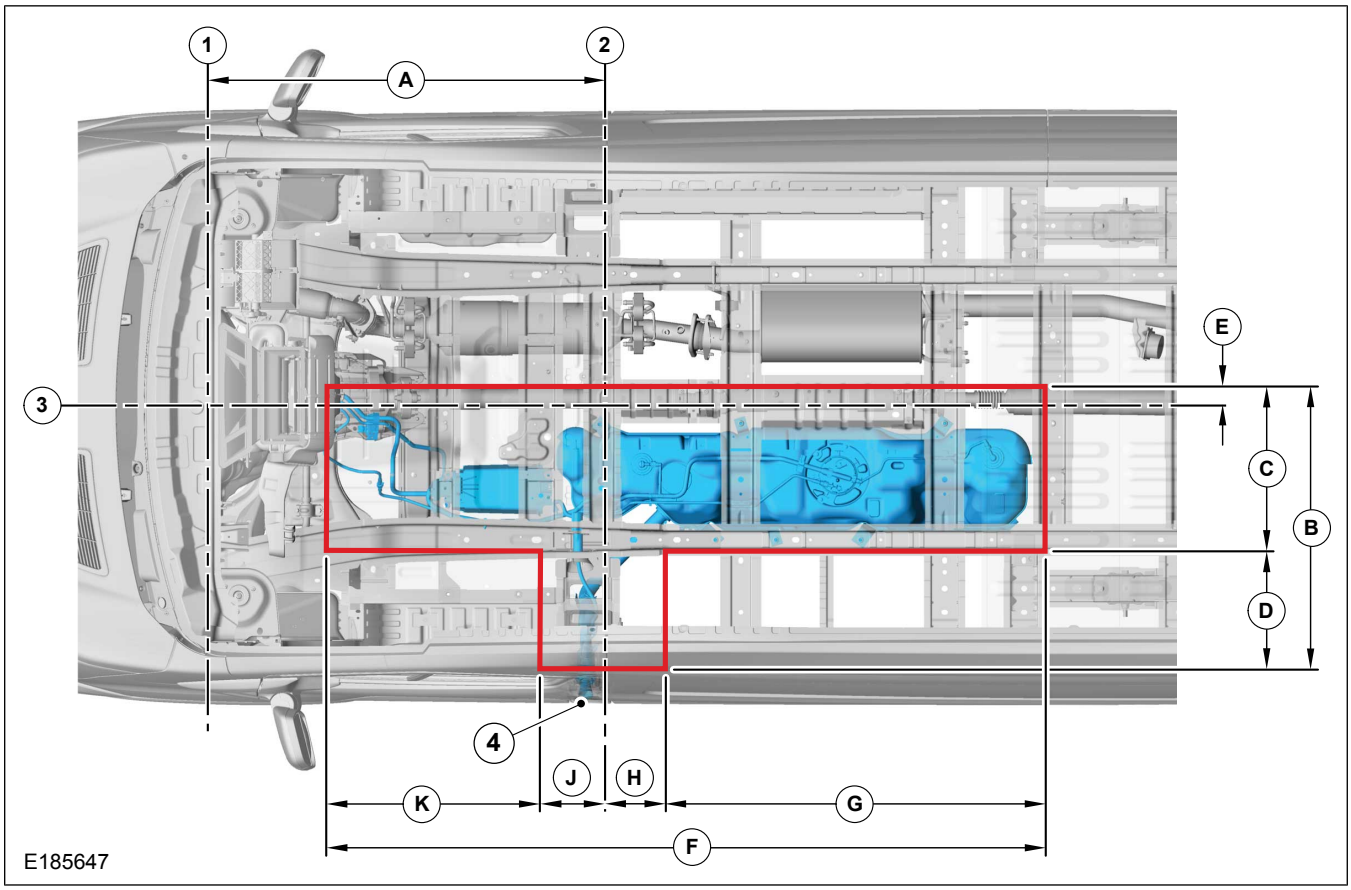
Boron Steel Parts Chassis Cab/Cutaway - Precautionary Drill or Weld Zones



5.1.4 Floor Precautionary Drill Zones

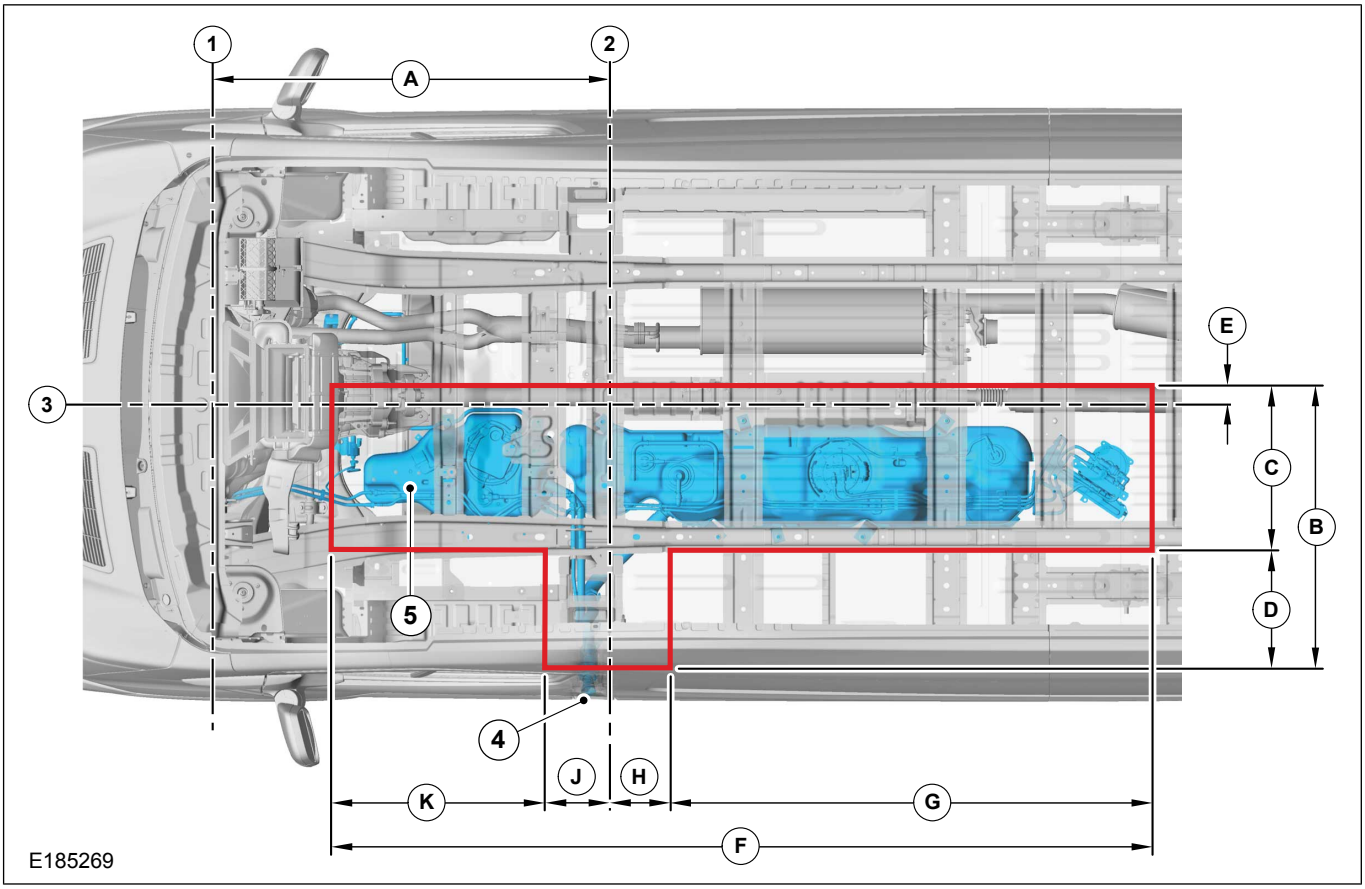
WARNING: Use care when drilling around fuel tank, lines, use drill shields where applicable, use drill depth gauges, don't point fasteners down /towards fuel components, use acorn style rounded cap nuts where possible.

Floor Precautionary Drill Zones - Fuel Tank 25 Gallons (94.6L) Gasoline



Floor Precautionary Drill Zones Dimensions			
1	Center line Front Wheel Axle	D	19.3" (490mm)
2	Center of 'B' Pillar	E	4.7" (120mm)
3	Center line of vehicle	F	104.1" (2645mm)
4	Fuel Fill - Driver's side B' Pillar	G	57" (1450mm)
A	50" (1271.5mm)	H	7.9" (200mm)
B	44" (1120mm)	J	7.9" (200mm)
C	24.8" (630mm)	K	31.3" (595mm)

Floor Precautionary Drill Zones - Fuel Tank 25 Gallons (94.6L) Diesel with UREA



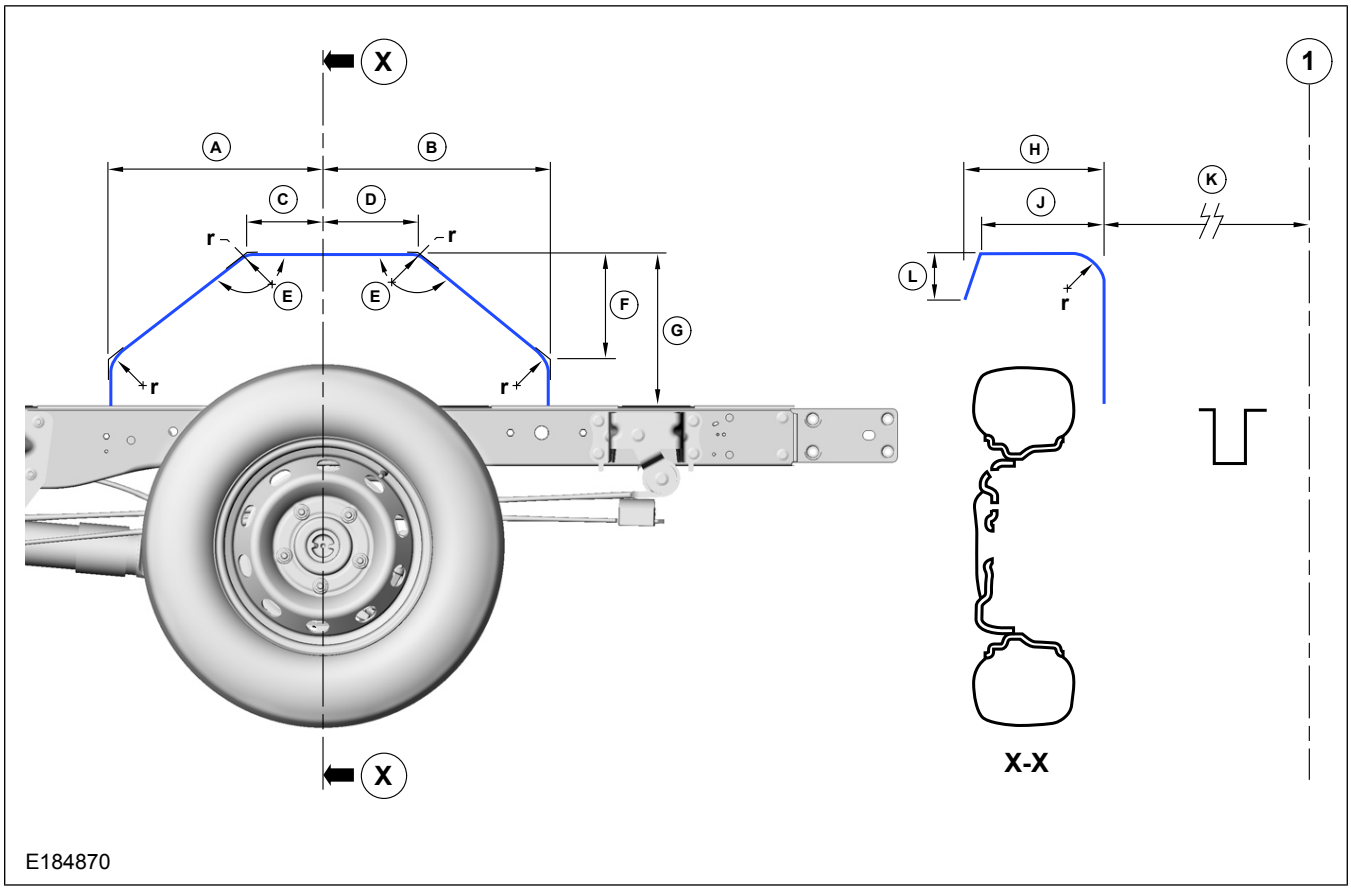
Floor Precautionary Drill Zones Dimensions			
1	Center line Front Wheel Axle	D	19.3" (490mm)
2	Center of 'B' Pillar	E	4.7" (120mm)
3	Center line of vehicle	F	113.2" (2875mm)
4	Fuel Fill - Driver's side 'B' Pillar	G	66.1" (1680mm)
5	UREA Tank	H	7.9" (200mm)
A	50" (1271.5mm)	J	7.9" (200mm)
B	44" (1120mm)	K	31.3" (595mm)
C	24.8" (630mm)	-	-

5.1.5 Integrated Bodies and Modifications

For integral structures such as ambulances or motor homes with increased rear overhang built onto the chassis the following applies:

- Reduced departure angles, e.g. rear entry step, should be discussed with the end user/customer. Consider removable components to avoid damage on ferries or low-loaders
- Unique spare wheel stowage may be required if obscured by rear step, check for accessibility
- The recommended dimensions for wheelhouses on modifications are outlined in Figures E184870 and E184871
- If a Chassis Cab or Cutaway vehicle is ordered with the optional spare tire, it will be necessary to provide access on the side of the second unit body for spare tire winch access. Alternatively, the spare tire maybe relocated

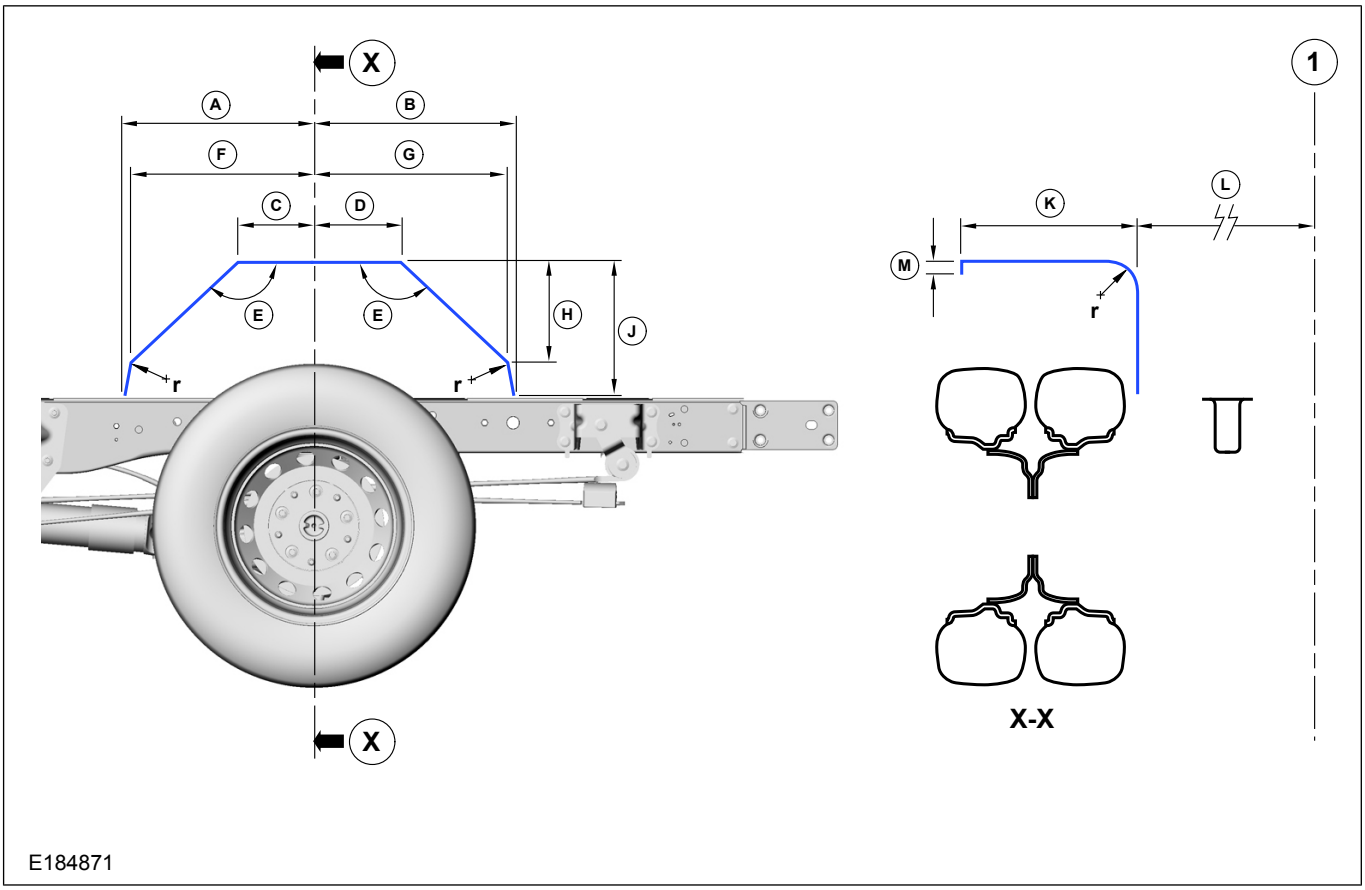
Chassis Cab/Cutaway with Single Rear Wheel Axle



E184870

Wheelhouse Dimensions for Chassis Cab/Cutaway with Single Rear Wheel Axle			
A	16.5" (418mm)	G	10.4" (265mm)
B	17.6" (448mm)	H	10.5" (268mm)
C	6.5" (165mm)	J	9.5" (242mm)
D	7.6" (194mm)	K	27.4" (696mm)
E	141°	L	3.1 (80mm)
F	7.8" (197mm)	r	2.9" (75mm)
1	Center line of Vehicle		
X	Section through Center of Wheelhouse		

Chassis Cab/Cutaway with Dual Rear Wheel Drive Axle



E184871

Wheelhouse Dimensions for Chassis Cab/Cutaway with Dual Rear Wheel Drive Axle			
A	16.5" (418mm)	G	17.2" (436mm)
B	17.6" (448mm)	H	7.7" (197mm)
C	6.5" (165mm)	J	10.4 (265mm)
D	7.6" (194mm)	K	15.9" (403mm)
E	141°	L	22.7" (577mm)
F	16" (406mm)	M	1.1" (27mm)
1	Center line of Vehicle	r	2.9" (75mm)
X	Section through Center of Wheelhouse		

5.1.6 Chassis Cab/Cutaway

WARNING: Excessive heat can build up from the exhaust system, in particular from the catalytic converter. Ensure adequate heat shields are maintained.

CAUTION: Uneven load distribution could result in unacceptable handling and braking characteristics.

When carrying out vehicle modifications the following points should be considered:

- Make sure that all of the reinforced holes provided in the Chassis/Cutaway frame top surface are used for full length bodies or sub-frames, see Figures E184867, E184868 and E184869
- Make sure that the vehicle structural integrity is maintained
- Do not drill into closed frame body members
- Make sure that the design for the body alterations or additional structure disperse the load evenly
- Re-paint metal edges after cutting or drilling. All metal edges must comply with exterior and interior protection legislation
- All fixings through the floor, sides or roof must be sealed

Refer to: 5.13 Corrosion Prevention (page 196).

- Ensure that any additional equipment in the vicinity of the fuel tank will not damage the tank in a crash condition

NOTE: The reinforcement plate in cab back panel to chassis member area must be maintained. Do not drill or cut into this area, see figure E167672 later in this section.

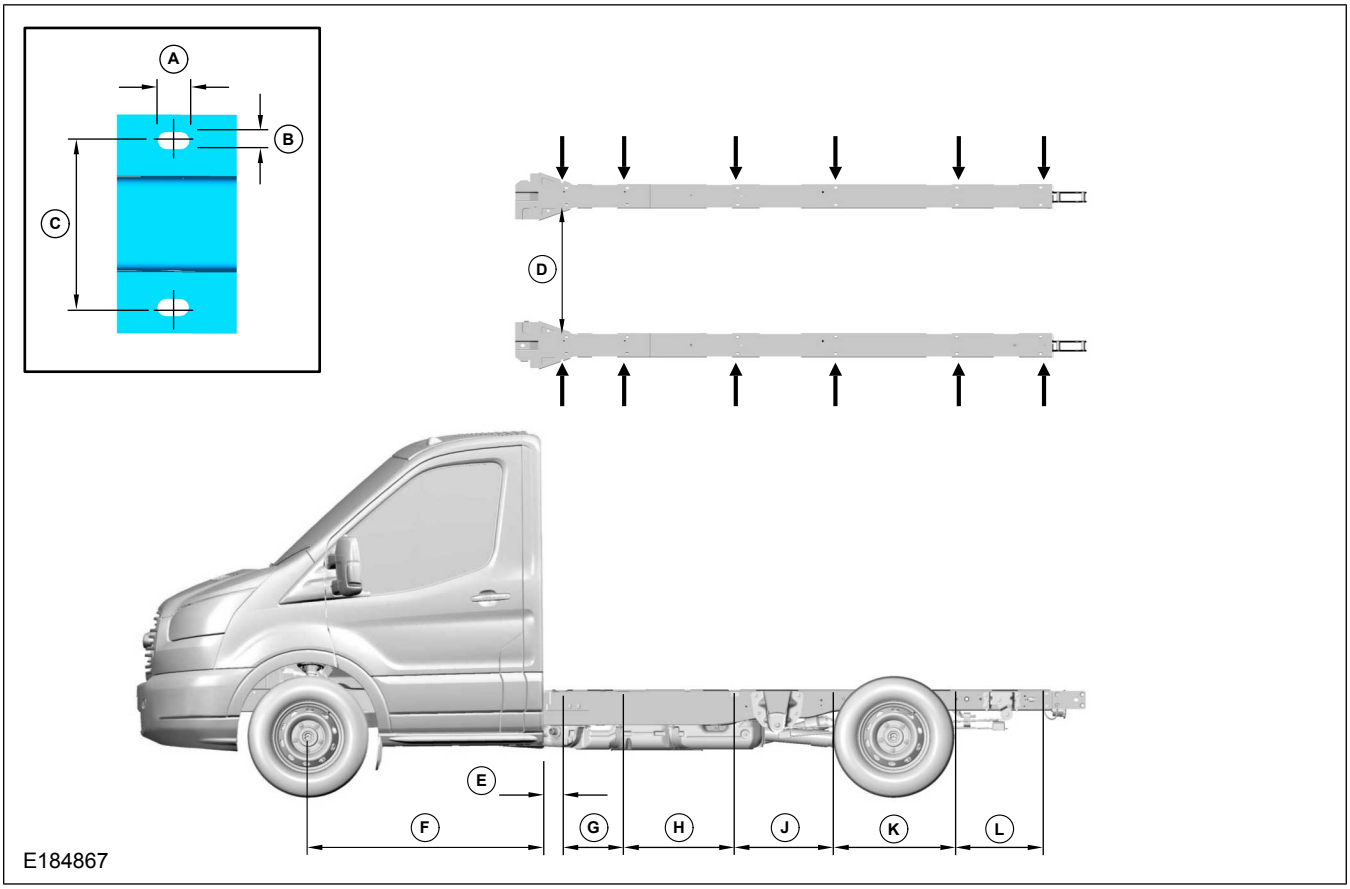
For additional information:

- Refer to: 5.14 Frame and Body Mounting (page 197).
- Refer to: 5.12 Roof (page 193).

For any modification structure attached to or mounted onto the base vehicle cab structure the following applies:

- Ensure that neither the modification structure nor the existing vehicle structure get pre-loaded by the assembly process
- Adhesive jointing is recommended but should be supplemented with mechanical fasteners to prevent initial peel and long term failure
- Spread bolt loads to minimize local stress

Body Attachment Holes - Chassis/Cutaway Frame Top Flange 138" Wheelbase

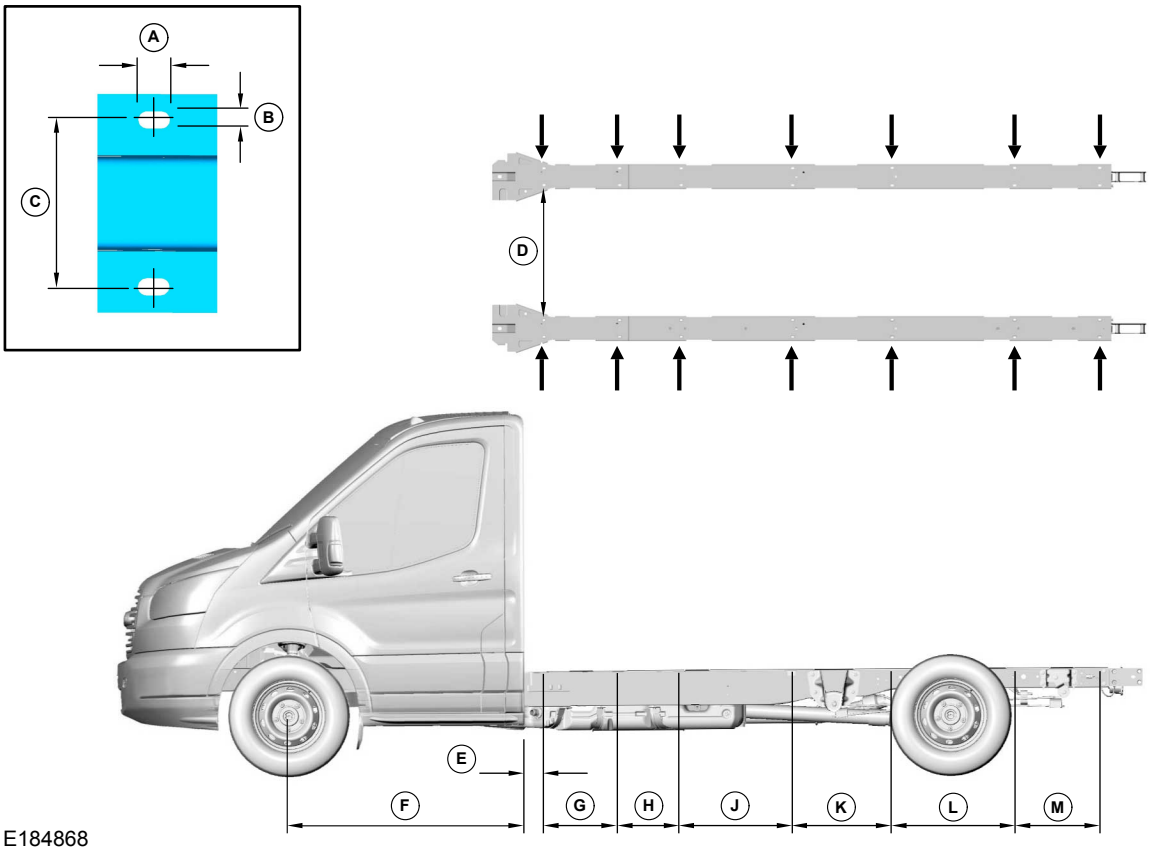


Body Attachment Holes -Chassis/Cutaway Frame Top Flange 138" Wheelbase			
A	0.7" (19mm)	G	14.5" (367mm)
B	0.4" (11mm)	H	26.2" (665mm)
C	3.9" (100mm)	J	23.3" (592mm)
D	31.5" (800mm)	K	28.7" (730mm)
E	4.2" (108mm)	L	19.9" (506mm)
F	55.4" (1407mm)	-	-

Refer to: 1.10 Package and Ergonomics (page 16).
Vehicle Dimensions for wheelbase dimensions.

See Incomplete Vehicle Manual (Standard F/CMVSS 301) for more information.

Body Attachment Holes - Chassis/Cutaway Frame Top Flange 156" Wheelbase

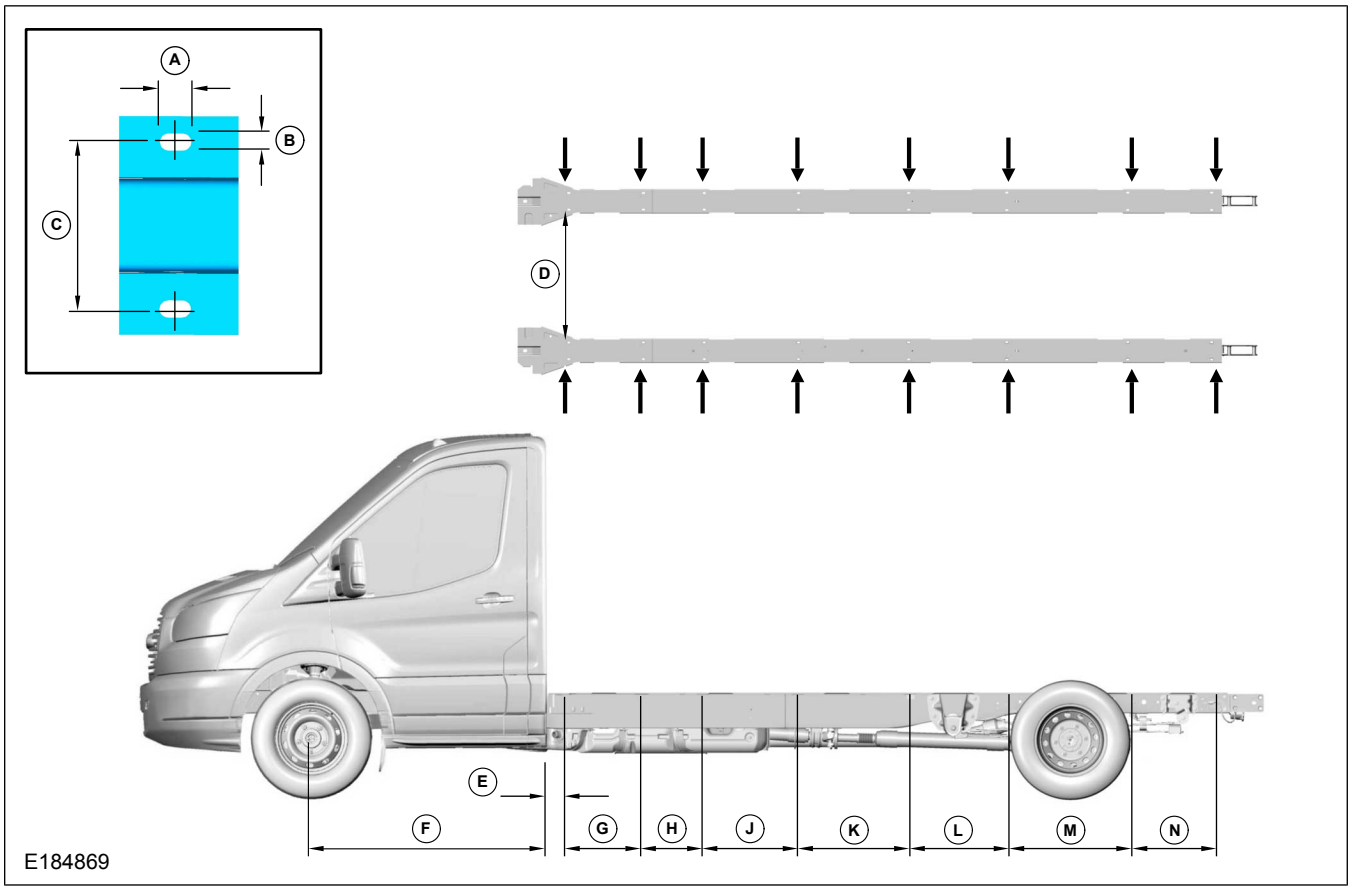


Body Attachment Holes - Chassis/Cutaway Frame Top Flange 156" Wheelbase			
A	0.7" (19mm)	G	17.7" (450mm)
B	0.4" (11mm)	H	14.5" (367mm)
C	3.9" (100mm)	J	26.2" (665mm)
D	31.5" (800mm)	K	23.3" (592mm)
E	4.2" (108mm)	L	28.7" (730mm)
F	55.4" (1407mm)	M	19.9" (506mm)

Refer to: 1.10 Package and Ergonomics (page 16).
Vehicle Dimensions for wheelbase dimensions.

See Incomplete Vehicle Manual (Standard F/CMVSS 301) for more information.

Body Attachment Holes - Chassis/Cutaway Frame Top Flange 176" Wheelbase

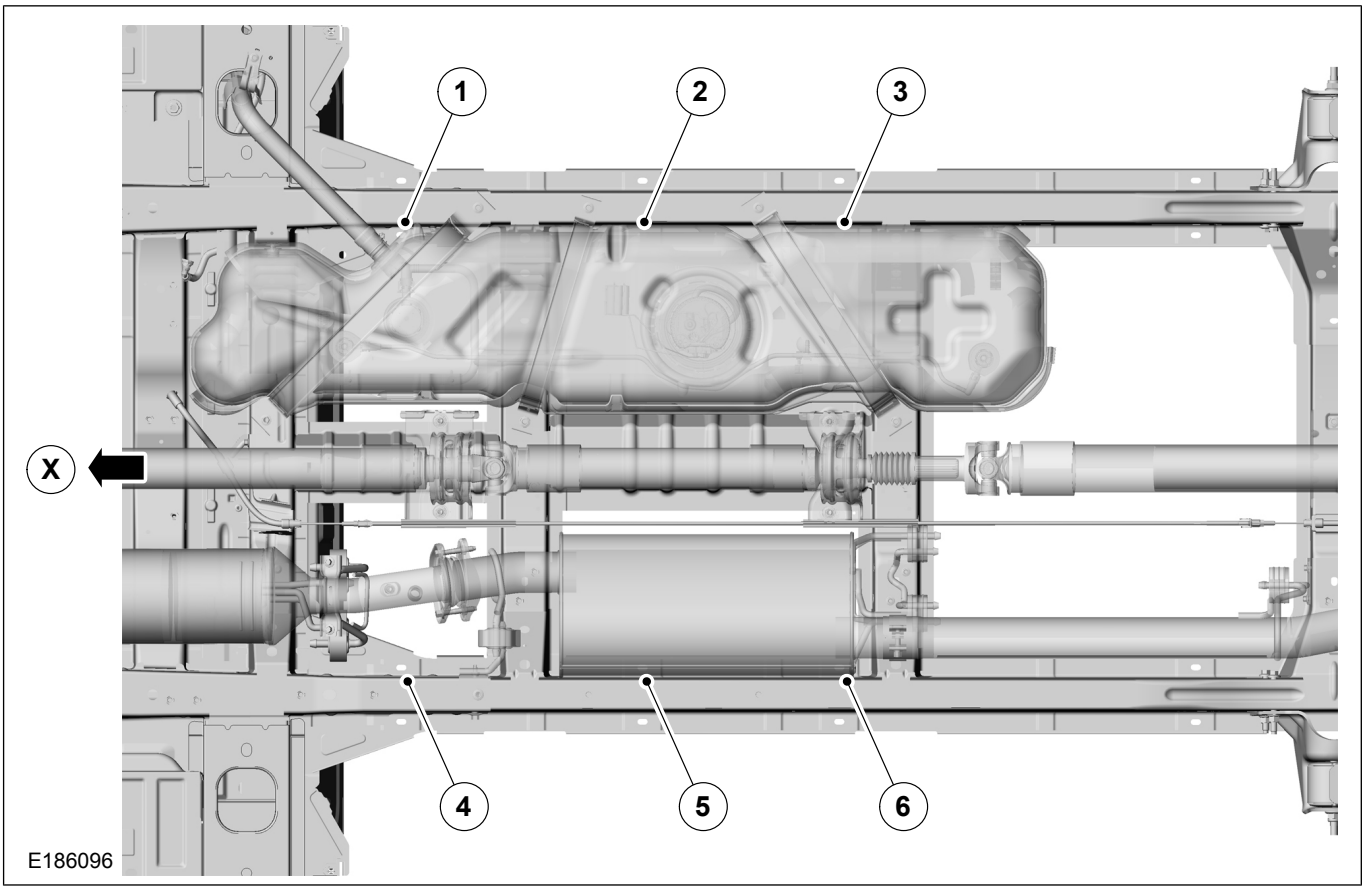


Body Attachment Holes Chassis/Cutaway Frame Top Flange 176" Wheelbase			
A	0.7" (19mm)	H	14.5" (367mm)
B	0.4" (11mm)	J	26.2" (665mm)
C	3.9" (100mm)	K	23.3" (592mm)
D	31.5" (800mm)	L	28.7" (730mm)
E	4.2" (108mm)	M	19.9" (506mm)
F	55.4" (1407mm)	N	22.1"(561mm)
G	17.7" (450mm)	-	-

Refer to: 1.10 Package and Ergonomics (page 16).
Vehicle Dimensions for wheelbase dimensions.

See Incomplete Vehicle Manual (Standard F/CMVSS 301) for more information.

Recommended Second Unit Body Fitting Strategy (Bottom View)

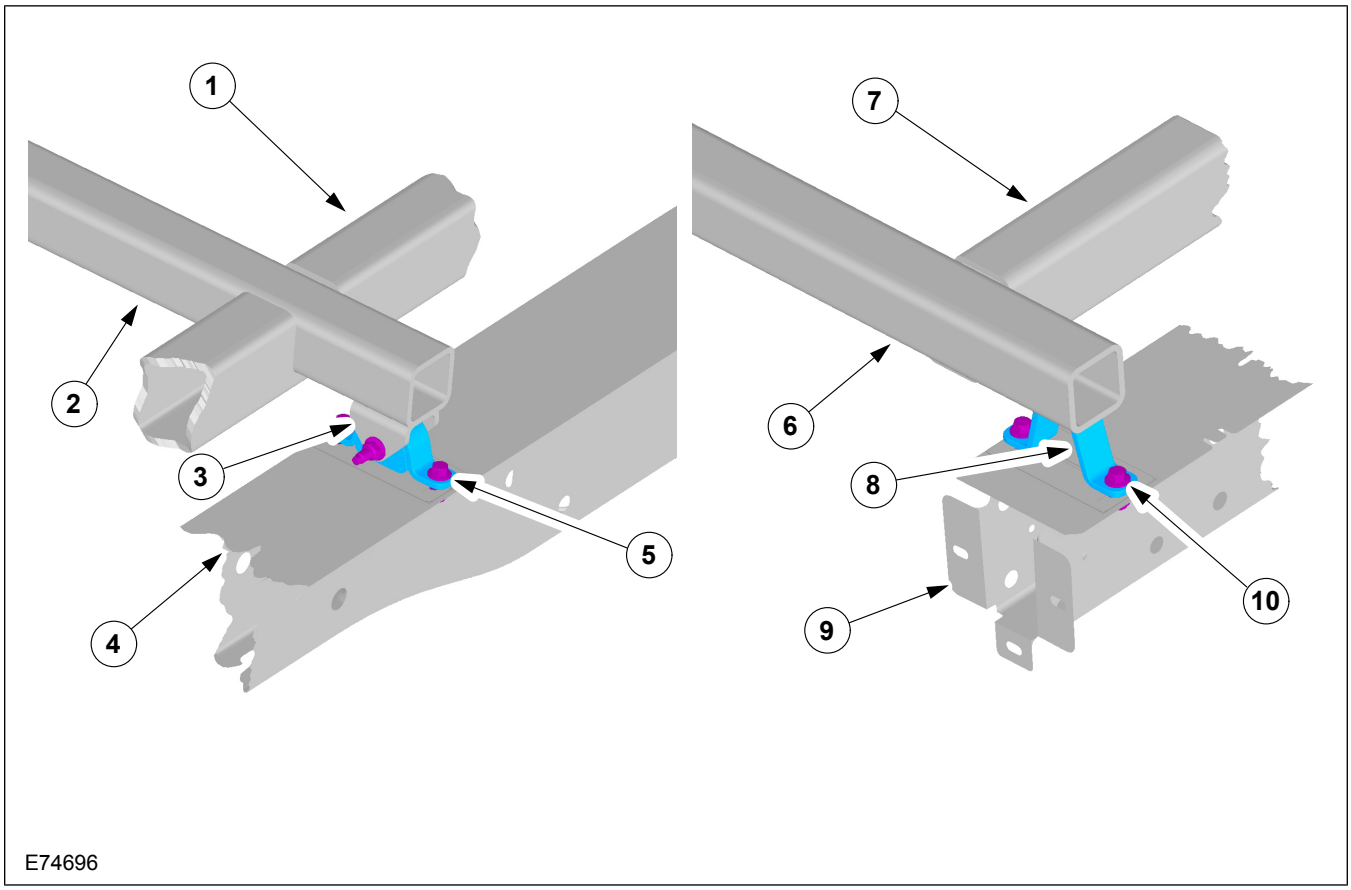


When mounting a Second Unit Body the attachment holes shown in figures E184867, E184868 or E184869 should be used.

NOTE: Some of the attachment holes are difficult to reach or obscured by the fuel tank see figure E186096. It is recommended that Inboard attachment points 1 and 4 should always be used however attachment points 2,3,5 and 6 can be omitted.

Consult Incomplete Vehicle Manual for further recommendations/requirements.

Sub Frame Attachment to Chassis Frame



E74696

Item	Description
1	Sub-frame Longitudinal
2	Sub-frame Outriggers
3	Compliant Mount
4	Chassis Frame
5	M10 Bolts and Self Locking Nuts
6	Sub-frame Outriggers
7	Sub-frame Longitudinal
8	Solid or Fixed Mount
9	Chassis Frame
10	M10 Bolts and Self Locking Nuts

It is recommended to design sub-frames in the way that there is no adverse strain on the vehicle structure. Use compliant and fixed mounts to attach to the vehicle body.

Sub-frame ends must be relieved at forward end to minimize local contact stress concentrations, see figure E74757

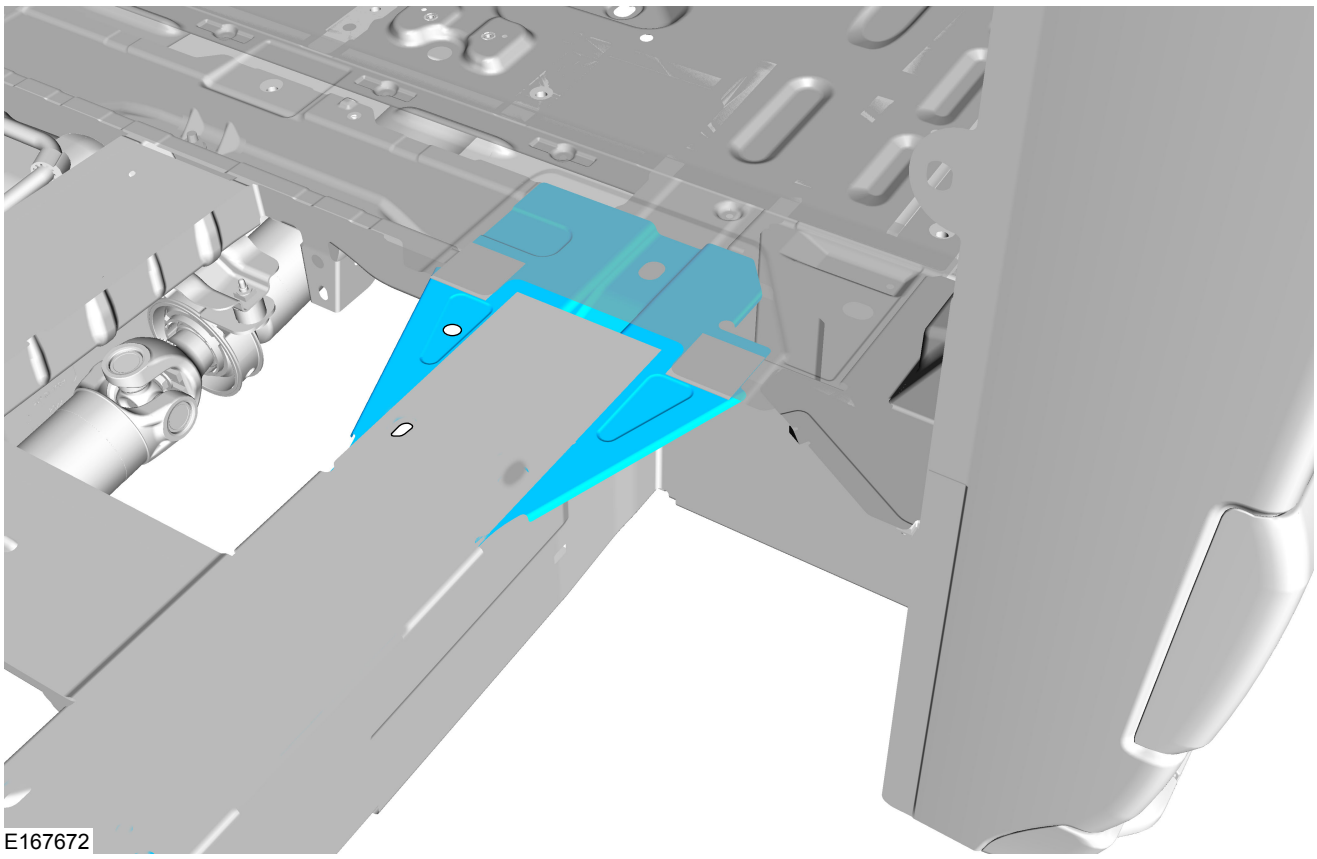
Refer to: 5.14 Frame and Body Mounting (page 197).

It is recommended to mount the longitudinal brackets with a clearance to the chassis frame top surface.

Stiff sub-frames, for example closed section longitudinal rigidly connected with similar section cross members, may damage the chassis frame by preventing its natural flexing. Therefore appropriate compliant mounts should be used. Please refer to E74696.

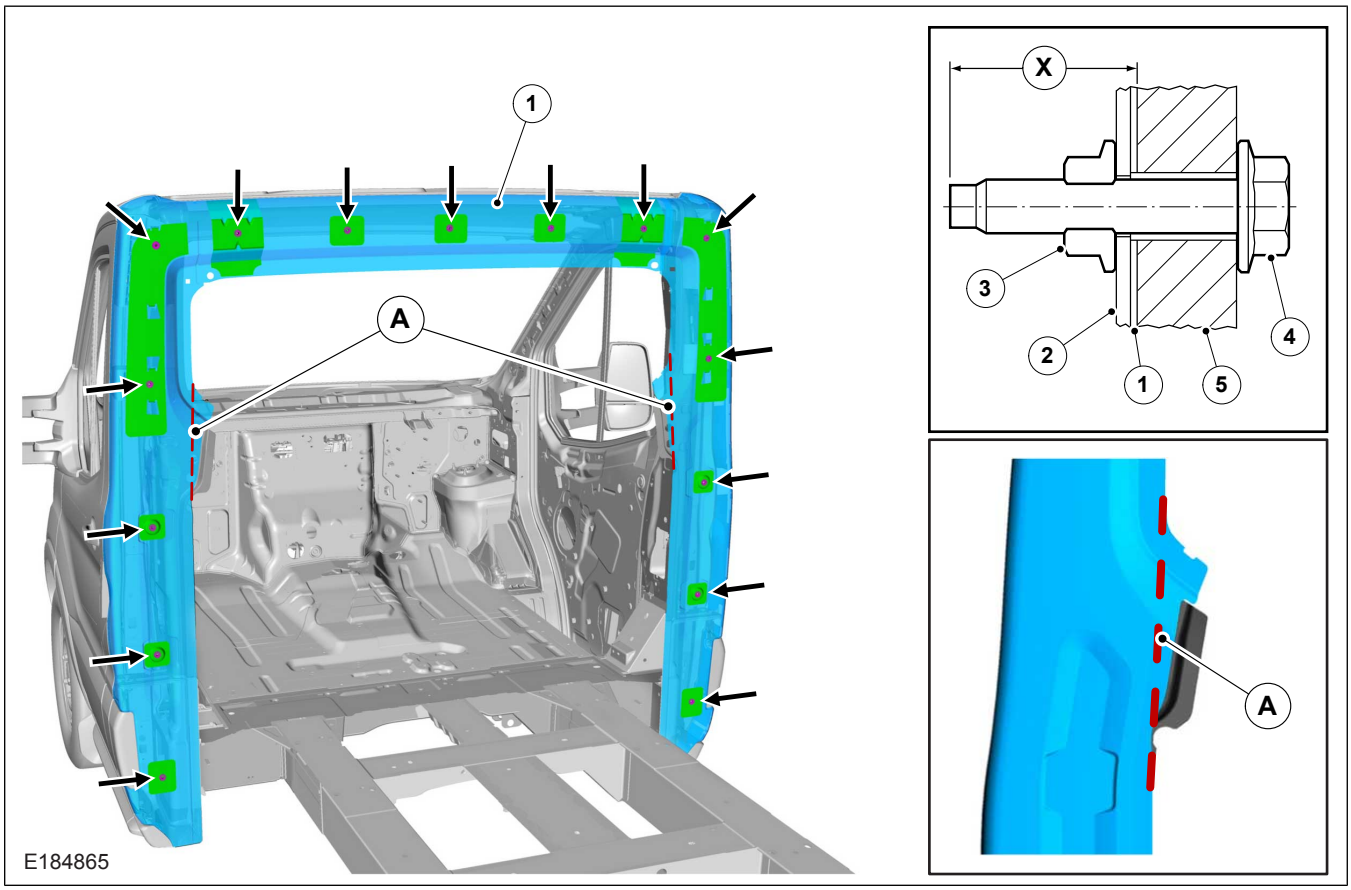
Each set of brackets must use 2 x 10 bolt grade 8.8 minimum.

Reinforcement Plate on Single Chassis Cab Vehicles



Do not drill or cut in the reinforcement plate on single chassis cab/cutaway vehicles.

5.1.7 Cutaways



Item	Description
A	Flange trim line
1	Cutaway flange with added reinforcement
2	Reinforcement plate (see positions arrowed)
3	Non threaded weld nuts (15x see positions arrowed)
4	Use MR8 TAPTITE 2000® bolts - not supplied (15x positions) or equivalent size, gauge, self tapping fastner.
5	Second Unit Body
X	Maximum intrusion 1" (25mm)

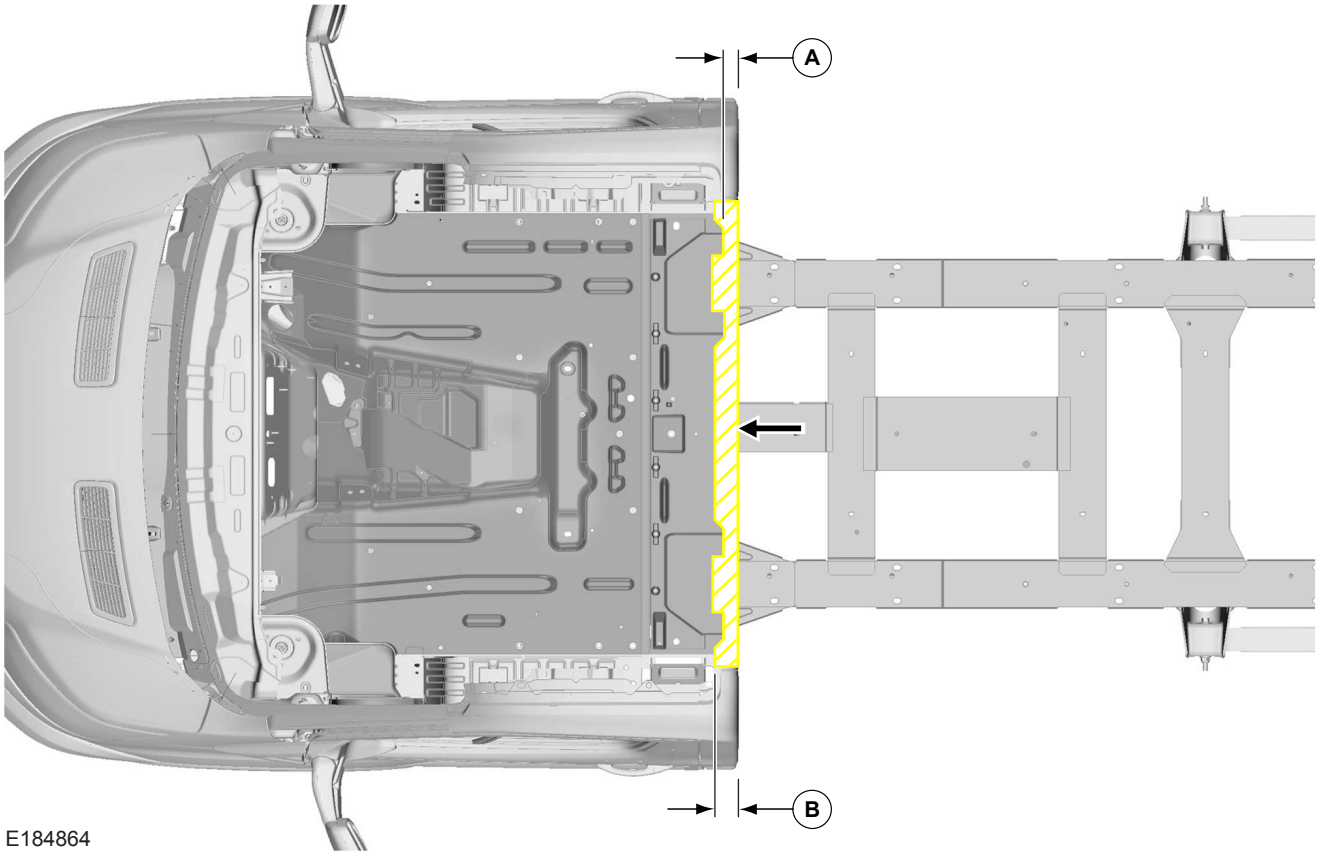
NOTE: When trimming the edge, do not cut further outboard than the trim line 'A' (Left hand side shown, right hand side symmetrically opposite) as shown in figure E184865. Do not cut outboard of the last spotweld joining the 2 panels together on each flange. The cut must be more than 0.2" (5mm) away from the last weld.

For attaching a second unit body to the Cutaway cabin, fifteen weld nuts are provided, see figure E184865. All fifteen weld nuts must be used. The bolts must not exceed 1" (25.4mm) intrusion into the vehicle cabin structure.

NOTE: If implementing a fully sealed body, a minimum of 23.3in² (150cm²) air extraction cross sectional area is required on each side of the vehicle cab. An ideal position for the extractors would be in the back panel of the cab.

If this is not feasible, then extractors should be situated rearward of the B-pillars such that there is a free airflow path equating to at least the minimum extractor effective cross sectional area, both upstream and downstream of each extractor, to maintain windshield defogging performance and door closing efforts. Extraction should not be installed near exhaust components nor areas exposed to potential fuel spillage.

Cutaway - Floor Spacer



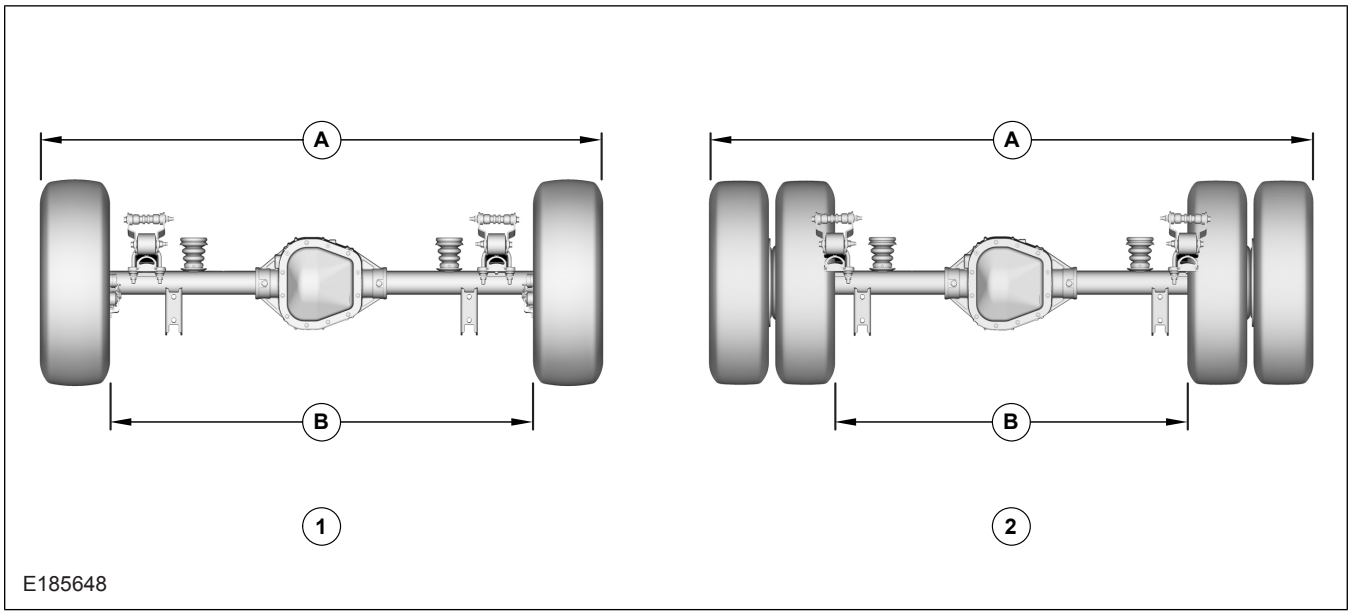
Item	Description
A	1.8" (45mm)
B	3.1" (77mm)

Cross hatched area shown in figure E184864 is a floor gap and will require a spacer plate (not supplied) to close off the gap on Cutaway vehicles for certain types of upfits including box vans, utility bodies and similar.

NOTE: Check Precautionary Drill Zones for the fuel tank before fitting a spacer plate.

NOTE: Added spacer and attachments through the floor must be sealed for water/exhaust fumes.

Cutaway Rear Axle



Chassis Cab/Cutaway Rear Axle			
Single Rear Wheel (1)		**Dual Rear Wheel (2)**	
A	78.3" (1987mm)	A	83.1" (211mm)
B	59" (1498mm)	B	48.4" (1230mm)

5.1.8 Front End Integrity for Cooling, Crash, Aerodynamics and Lighting

Cooling Continuous air flow through the front end and engine compartment is not to be hindered by adding any additional equipment.

Lighting Do not alter the lighting system.

Crash Do not cut, drill or weld any parts that are load path relevant in case of crash. Do not add material in the crash zone. This could affect the crash sensor calibration.

The side airbag system is not permitted if:

- A swiveling device is fitted on the front seats
- Any additional material or structure is attached to the B-pillar inner and/or outer area

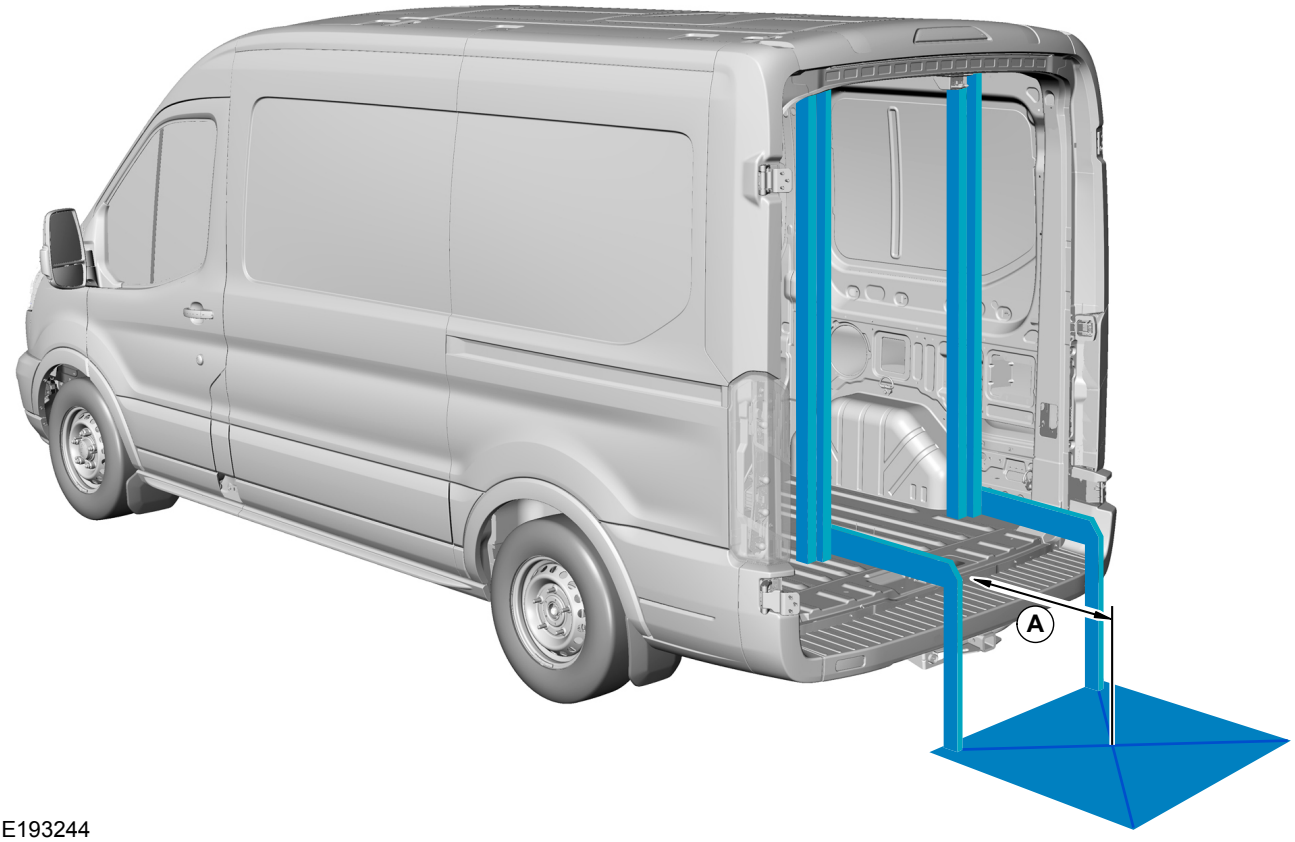
Aerodynamics All aerodynamic drag reduction devices should not hinder the performance of cooling system, lighting and crash requirements.

For a summary of aerodynamic drag reduction device refer to 15 Transit Body Builder Layout Book on the BBAS website: https://fordbbas.com/topics/2015/2015_Transit_BBLB-Prelim.pdf

Installation of the drag reduction devices should comply with the "no drill zone" requirement.

5.2 Hydraulic Lifting Equipment

5.2.1 Hydraulic Liftgate



E193244

Item	Description
A	39" (1000mm)

It is recommended to fix lift framework on bottom and on top side by using reinforcing plates and through bolts. It is also recommended to design and/or locate the reinforcing plates in a way that load can be routed into adjacent reinforced body structure.

Hydraulic under-slung tail lifts are not recommended for Transit Van or Wagon.

For Chassis Cab and Cutaway with tail lift design it is recommended to use unique body sub-frame for fixing to Chassis Cab and Cutaway structure.

5.3 Racking Systems

5.3.1 Racking Systems

WARNING: Racking Systems should not be designed in a way that allows for the Center of Gravity to be raised beyond specified limits.

Refer to: 1.12 Load Distribution (page 20).

WARNING: Racking that is added must be designed to enable the user to secure items on the rack to avoid items shifting during motion.

For attaching a racking system it is recommended to use the marked areas shown in figure E192242.

NOTE: Upper fixing locations are not structural and take a 30kg maximum load only.

- Frames should be rigid, self-supporting and bolted through the floor, use reinforcements on the underfloor
- It is not recommended to drill through the floor in combination with plastic load floor liners
- For alternatively fixing through the floor to the side members refer to Frame and Body Mounting section of this manual, Figure E176203 Frame Drilling and Tube Reinforcing.

  Refer to: 5.14 Frame and Body Mounting (page 197).
- Load compartment tie downs can also be used for additional fixing locations.

  Refer to: 5.4 Loadspace (page 176).
- Ensure proper sealing against ingress of water, salt, dust, after cutting or drilling the body. Use Ford approved sealing and finishing material, and underbody corrosion protection
- To minimize stress in body side upper area additional cross brace roof bows are to be used
- If linings are planned for the inside of the load area. All racking through bolts must be designed to be accessible through the lining to the body structure with spreader plate
- No load bearing fixing to the lining only
- Vehicle should be equipped with a bulkhead to give best protection to driver and front passengers
- Preferably, there should be a rack each side to balance the vehicle load

For designing glass carrying rack on body side outer, construct internal structure and bolt through the body side to the internal structure, using the recommended fixing locations, see figures E192242 and E176512, or load compartment tie downs.

Refer to: 5.4 Loadspace (page 176).

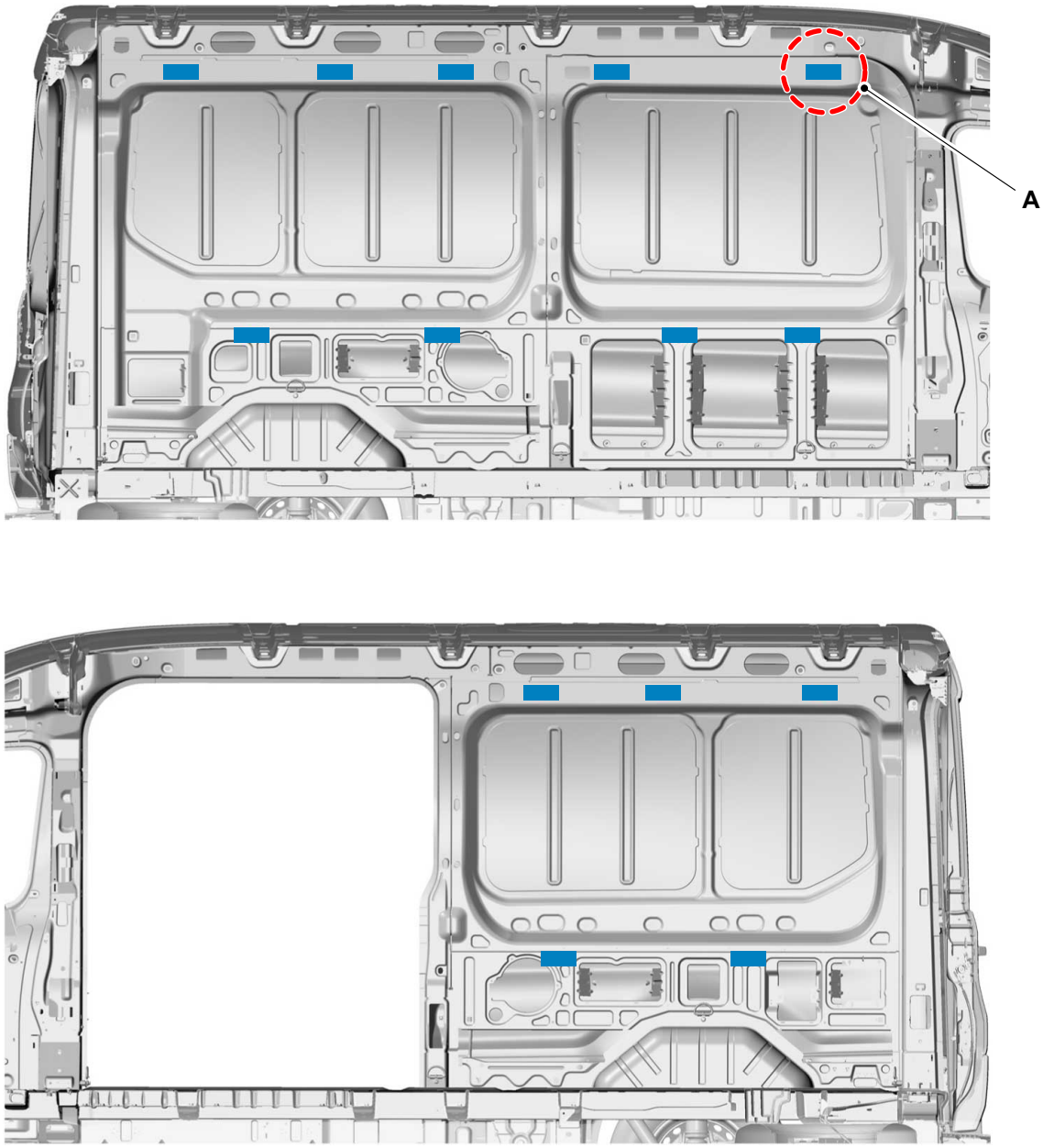
For additional information

Refer to: 5.13 Corrosion Prevention (page 196).

For additional information on No Drill Zones

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).
Refer to: 5.1 Body (page 155).
Refer to: 5.5 Body Closures (page 177).

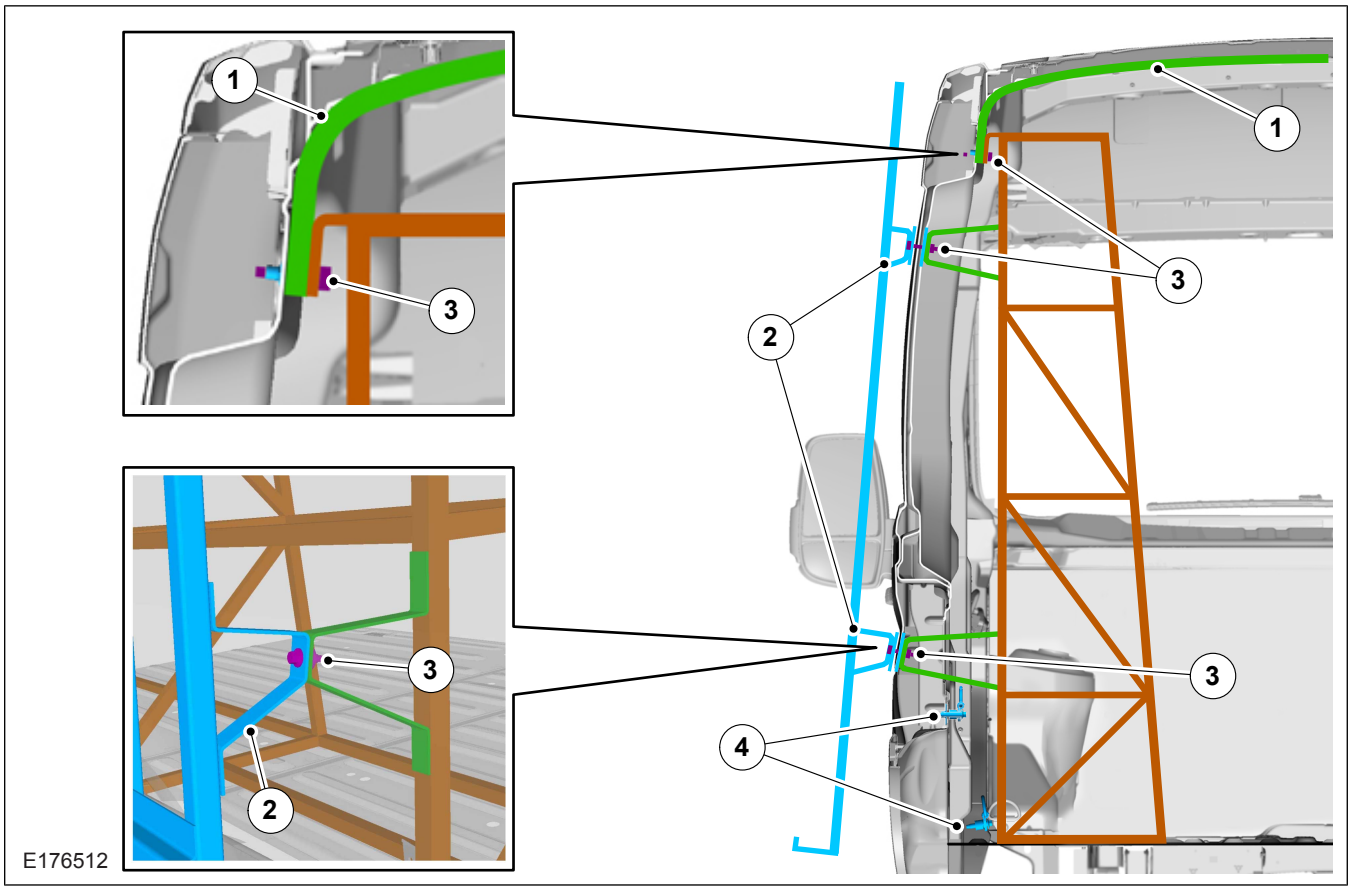
Recommended Fixing Locations (Medium Roof shown)



E192242

Item	Description
A	Low Roof Vehicles do not have this fixing location

Glass Racking on Outside of Van



Glass Racking on Outside of Van - Through Fixed to Internal Strong Structure (Recommended Minimum)

Item	Description
1	Full width cross bow brace.
2	Load bearing attachments, through body side to internal structure (2x minimum top and bottom).
3	Through bolts.
4	Load compartment tie down loops.

For designing glass carrying rack on bodyside outer, the following unique requirements are recommended:

- Construct the internal structure and bolt through the body side to the external structure, see figure E176512
- Internal structures should be rigid, self-supporting and bolted through the floor. Use reinforcements on the underfloor
- Avoid the no-drill zones when selecting fixing locations.

  Refer to: 4.1 Wiring Installation and Routing Guides (page 49).
- It is recommended to balance the vehicle load.

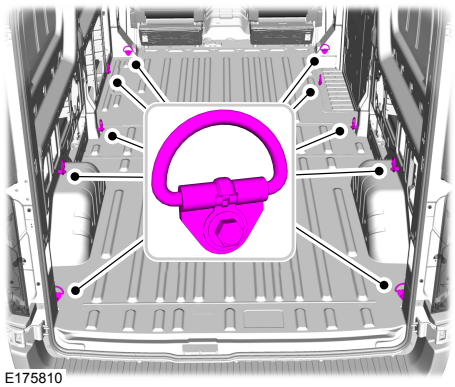
  Refer to: 5.4 Loadspace (page 176).
- Distribute the force equal to the fixed structure

5.4 Loadspace

5.4.1 Load Compartment Tie Downs

All vehicles are fitted with load compartment tie downs, these are all 'D' rings as shown in E175810. Not all vehicles will have all locations shown, it will depend on the base vehicle.

Refer to: 5.3 Racking Systems (page 173).


E175810

5.5.1 Security, Anti Theft and Locking System

NOTE: It is not recommended to alter the locking system or damage the security shielding around the lock and latch.

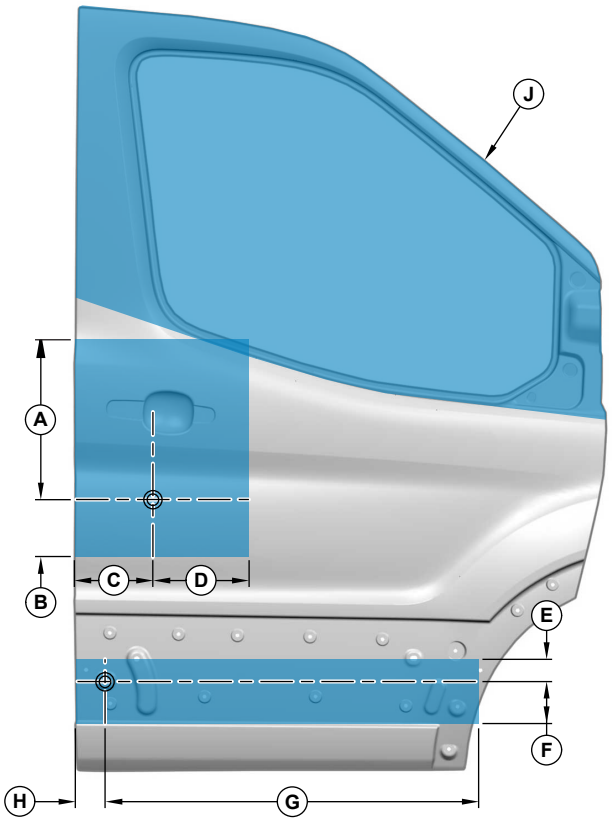
To avoid locking system security complications, it is recommended to discuss with the local Ford dealer prior to modifications taking place.

When removing and reapplying door seals take care to fit correctly, using the same seals as this is critical to door closing efforts. Any modification to the sealing flanges or surfaces will require consultation with your local Ford dealer. This may also include air extraction/venting adjustments to assist door close efforts if significant changes to closures are required.

The Body Control Module is designed to work specifically with the Ford Transit lock and latch mechanisms and therefore drives latches to lock and unlock for specific time periods. Additional power locking functionality should be based around the use of additional Ford Transit latch mechanisms. Additional latches can be driven via relays connected in parallel with existing latches.

The following figures outline the areas in which it is not advisable to drill.

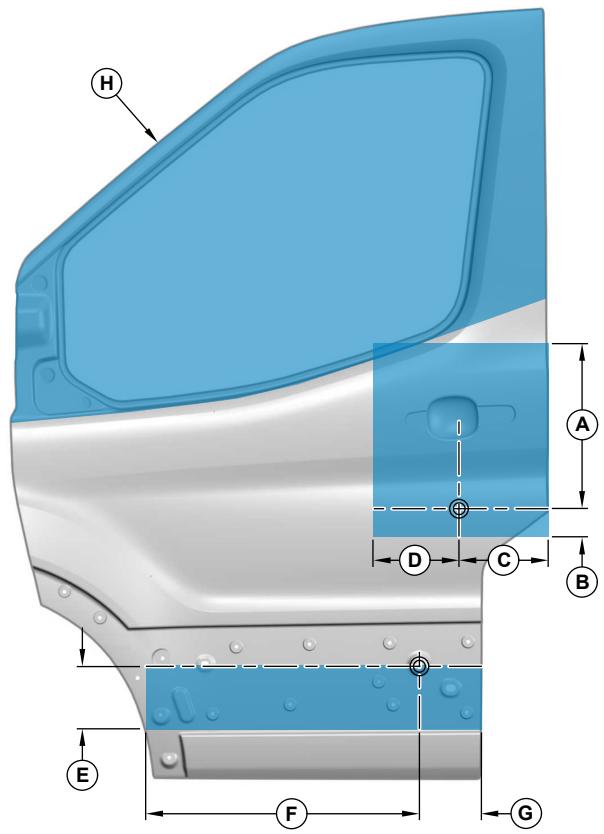
No Drill Zones - Right Hand Side Door



E188546

Item	Description
A	16.93" (430mm)
B	1.97" (50mm)
C	7.87" (200mm)
D	5.91" (150mm)
E	0.79" (20mm)
F	3.15" (80mm)
G	31.5" (800mm)
H	2.56" (65mm)
J	No drill zone - Airbag deployment

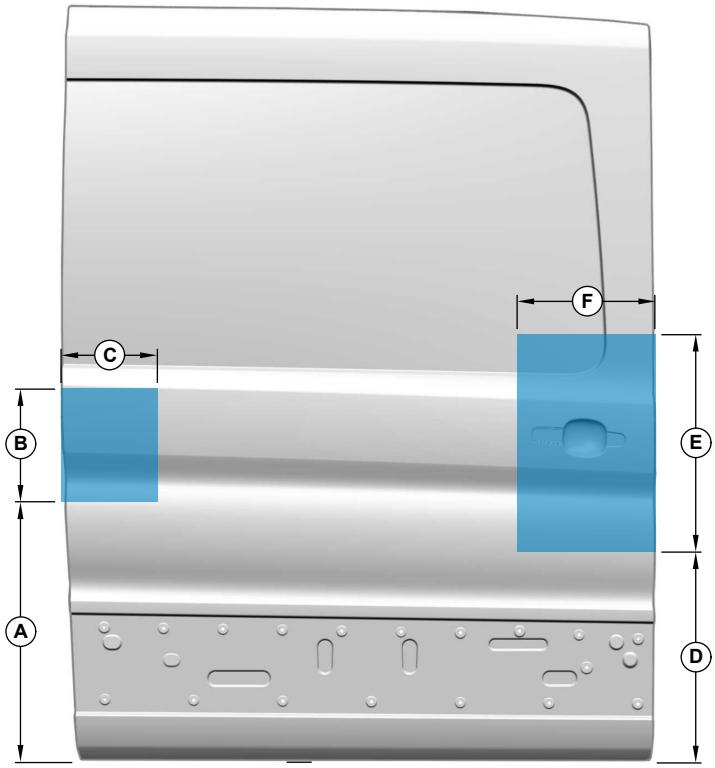
No Drill Zones - Left Hand Side Door



E188547

Item	Description
A	16.93" (430mm)
B	1.97" (50mm)
C	7.87" (200mm)
D	5.91" (150mm)
E	3.94" (100mm)
F	23.62" (600mm)
G	2.76" (70mm)
H	No drill zone - Airbag deployment

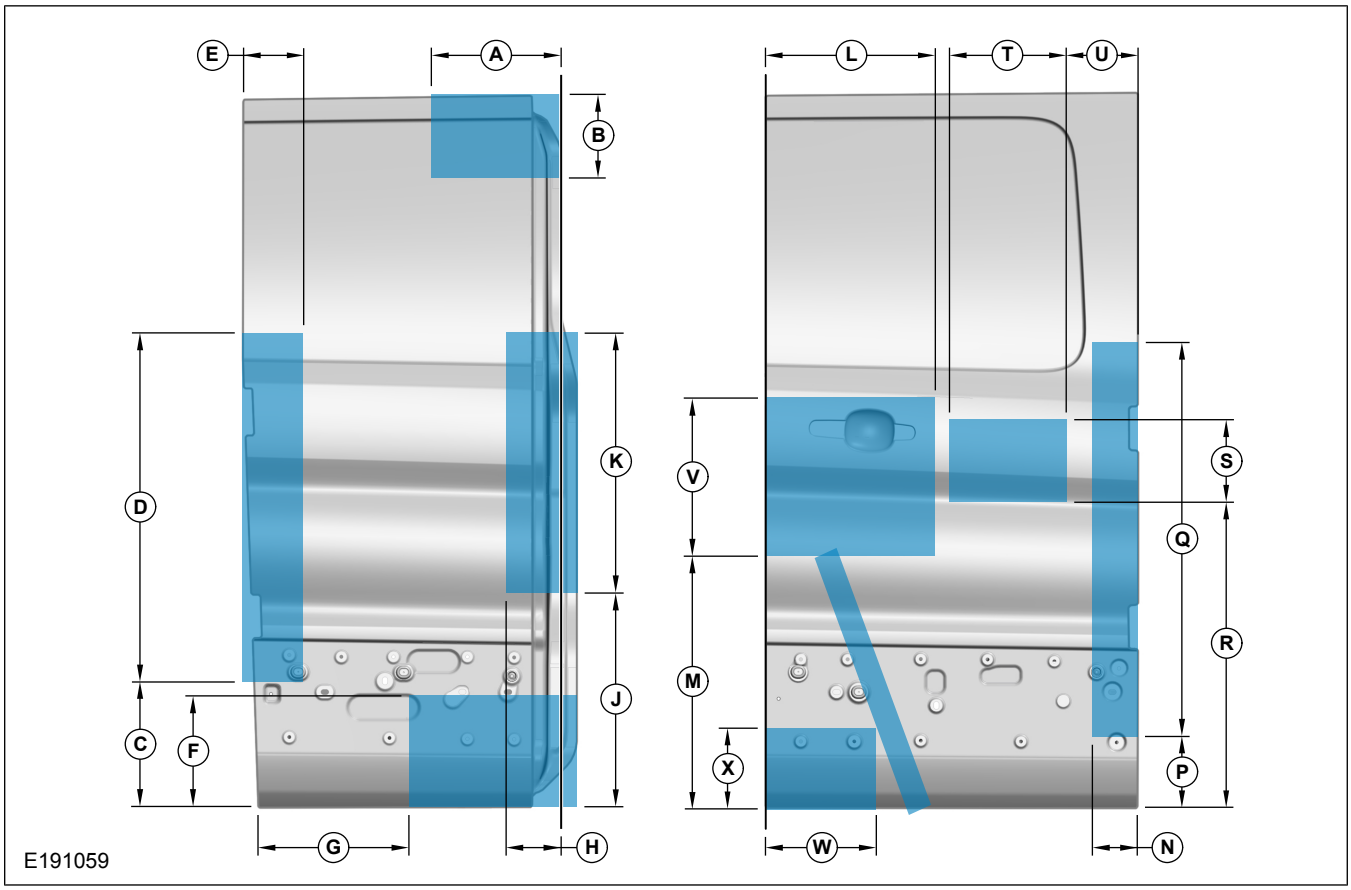
No Drill Zones - Side Sliding Doors



E188548

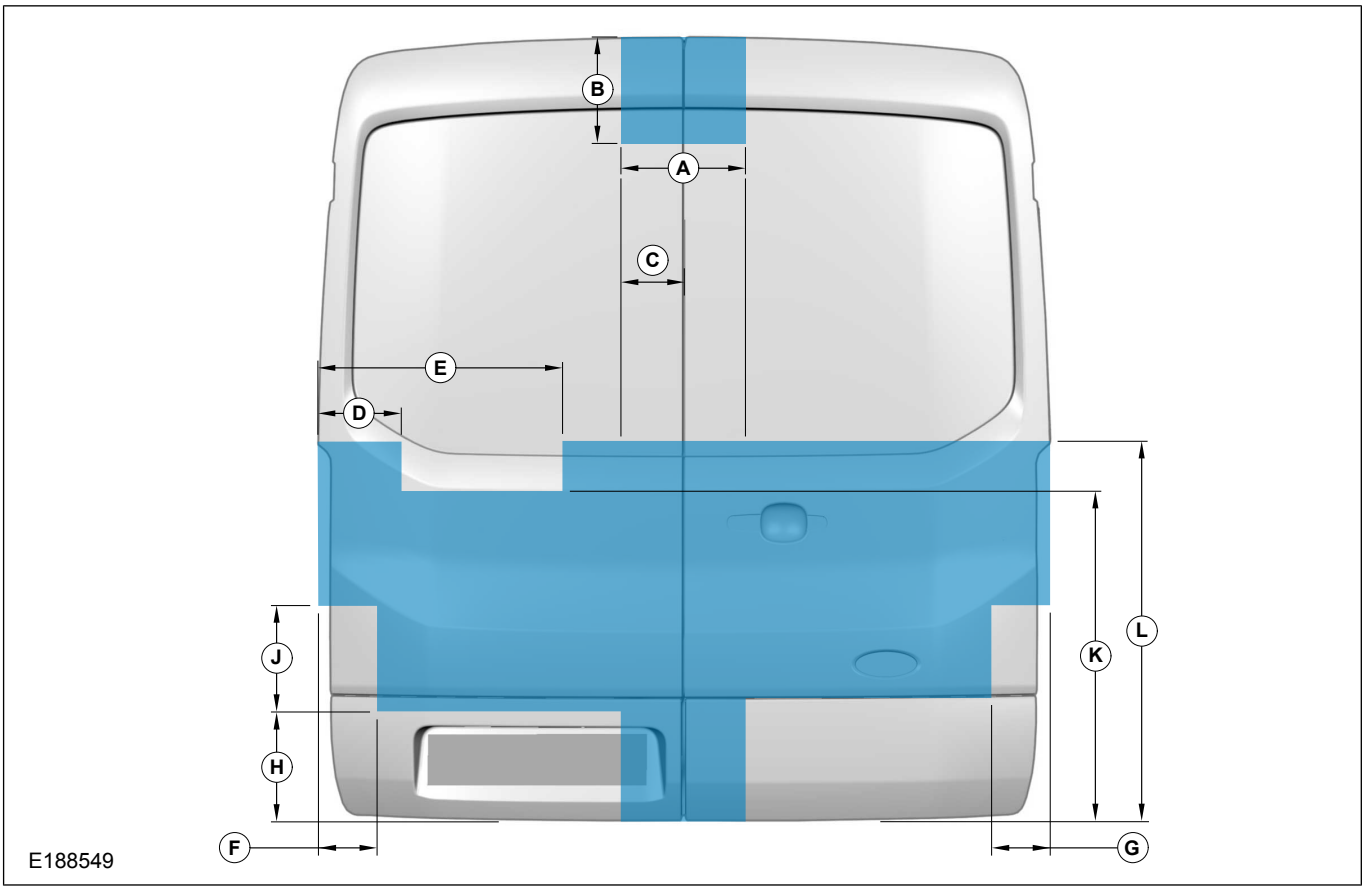
Item	Description
A	21.65" (550mm)
B	13.78" (350mm)
C	5.91" (150mm)
D	19.69" (500mm)
E	24.41" (620mm)
F	17.72" (450mm)

No Drill Zones - 60/40 Opening Side Cargo Doors



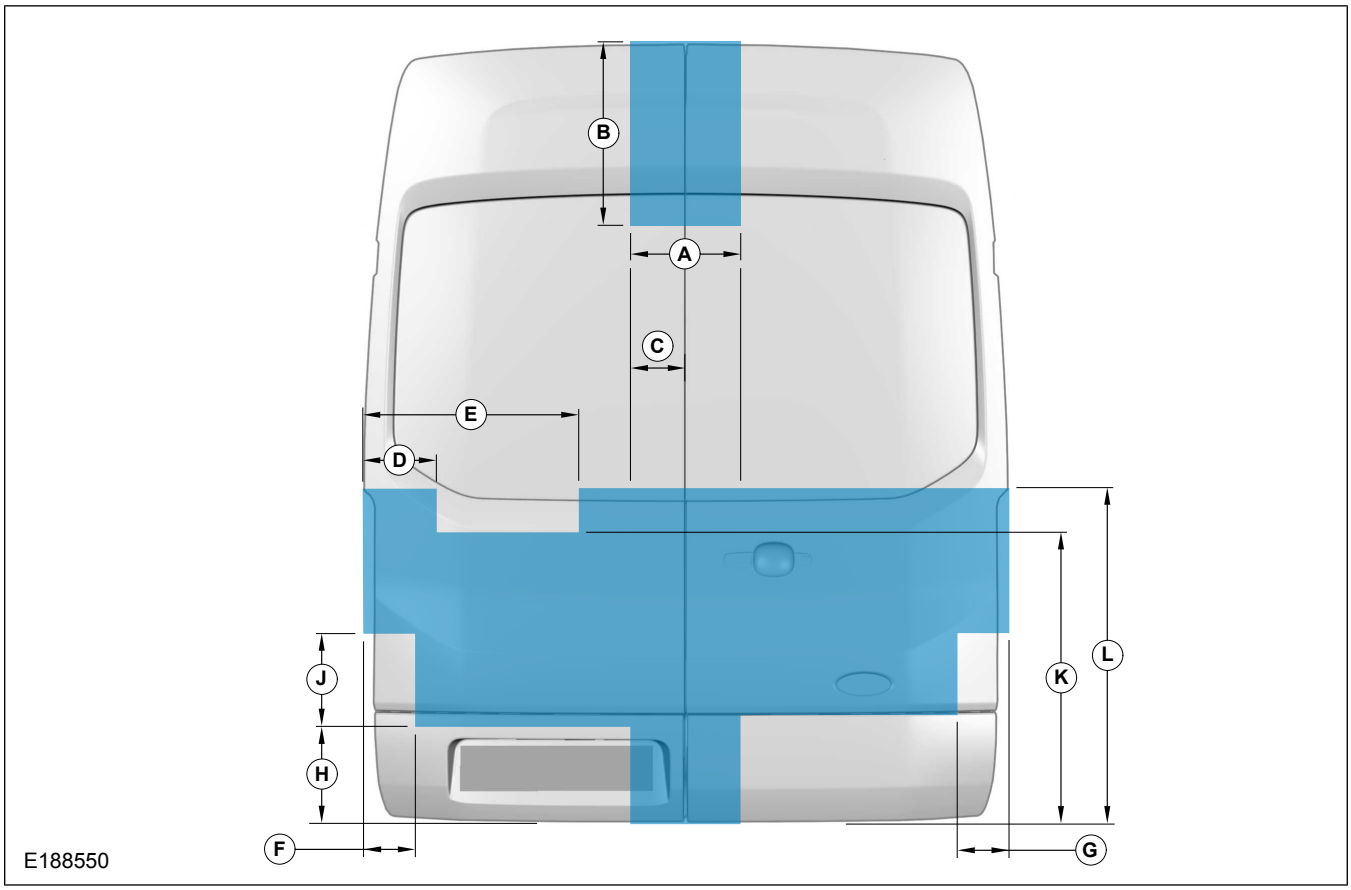
Item	Description
A	9.84" (250mm)
B	7.09" (180mm)
C	11.81" (300mm)
D	30.31" (770mm)
E	4.33" (110mm)
F	10.63" (270mm)
G	14.17" (360mm)
H	6.3" (160mm)
J	19.69" (500mm)
K	21.65" (550mm)
L	14.57" (370mm)
M	19.29" (490mm)
N	4.33" (110mm)
P	6.5" (165mm)
Q	34.25" (870mm)
R	28.35" (720mm)
S	3.94" (100mm)
T	7.09" (180mm)
U	7.09" (180mm)
V	17.91" (455mm)
W	9.45" (240mm)
X	5.91" (150mm)

No Drill Zones - Rear Cargo Doors, Low and Medium Roof



Item	Description
A	13.39" (340mm)
B	12.6" (320mm)
C	6.69" (170mm)
D	9.84" (250mm)
E	23.62" (600mm)
F	7.87" (200mm)
G	7.87" (200mm)
H	11.81" (300mm)
J	11.81" (300mm)
K	31.5" (800mm)
L	36.22" (920mm)

No Drill Zones - Rear Cargo Doors, High Roof



Item	Description
A	13.39" (340mm)
B	21.7" (550mm)
C	6.69" (170mm)
D	21.7" (550mm)
E	13.39" (340mm)
F	7.87" (200mm)
G	7.87" (200mm)
H	11.81" (300mm)
J	11.81" (300mm)
K	31.5" (800mm)
L	36.22" (920mm)

5.6 Interior Trim

5.6.1 Load Compartment Interior Lining

Do not damage the lock, hinge, latch or check arm system (electrical cables, release system) when applying interior lining.

Be careful not to damage the weather shield (water shield covering inner door access hole) when removing or applying interior door trim.

WARNINGS:

Plan fixing points for other fitments such as racking to ensure through bolting can be achieved. Fixing to the lining material may be inadequate for normal safe operation of the vehicle.

Varnish or paint wooden interior cargo area panels if exposed to high humidity conditions.

The additional weight of the linings on doors may require additional reinforcements to the door and pillar at the hinge and check mechanism.

5.6.2 Plywood Lining/Cladding

CAUTION: Do not drill into the vehicle before checking 'No Drill Zones' and electrical wire routing.

Refer to: 4.1 Wiring Installation and Routing Guides (page 49).
Refer to: 5.5 Body Closures (page 177).
Refer to: 5.1 Body (page 155).

- Panels should be precision cut by machine, not by hand jigsaw, to reduce rough edges and splinters
- Panels should be pre drilled
- Do not drill through floor panels, use existing load lashing points when securing the panels
- It is recommended that when fitting a plywood floor that it is joint free
- Use aluminum floor trims
- Plywood should be water resistant (WBP, water and boil proof)
- It is recommended to use 9mm thickness for floors and 6mm thickness for side and door lining

5.7 Rear View Mirrors

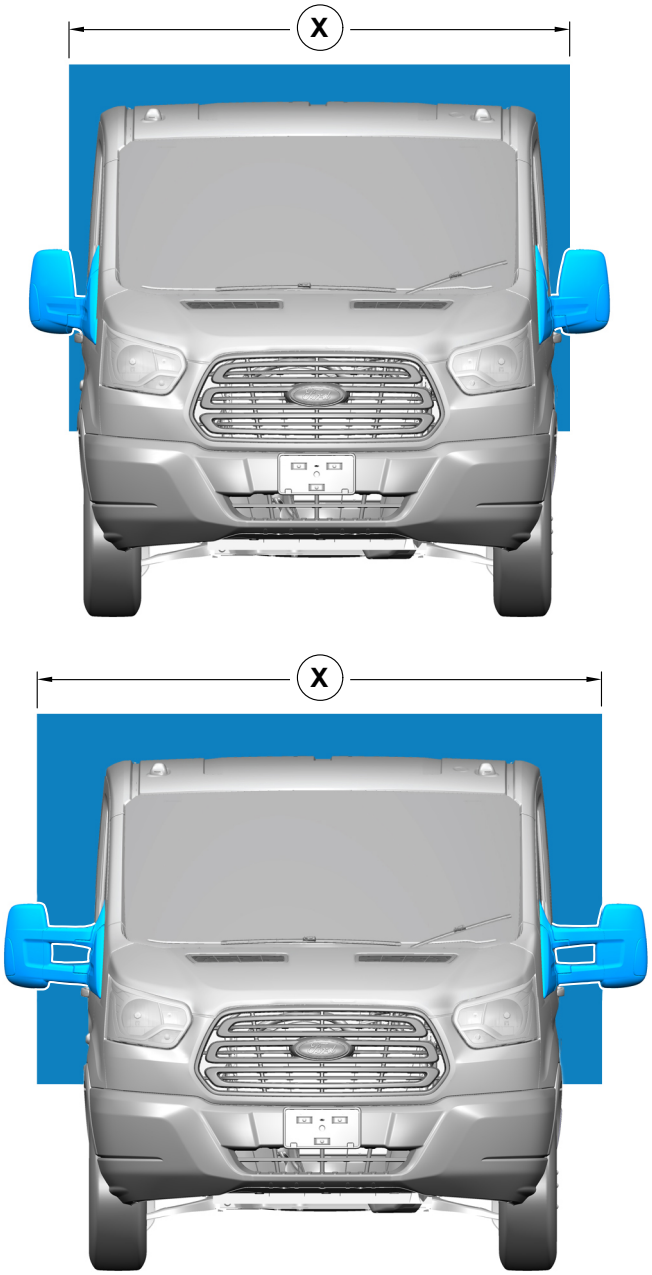
5.7.1 Door Mirrors

Short Arm Mirrors allow vehicle or trailer maximum widths of up to 86" (2184mm).

Long Arm Mirrors allow vehicle or trailer maximum widths of up to 96" (2438mm).

For availability of short and long arm mirrors or the less mirrors option, please contact your local Ford dealer.

NOTE: Vehicle modifiers must ensure that second unit body modifications comply with F/CMVSS requirements as specified in the IVM Manual.



E183991

5.8 Seats

NOTE: Care should be taken to properly wrap restraints to avoid contaminants during any modifications.

NOTE: When reassembling the seat and the seat belt use specified bolts and ensure to apply the specified torque. For torque specifications consult the workshop manual.

NOTE: Ensure that all electrical connections between the airbag and seat are reassembled where present.

NOTE: Cycle seat belt after assembly to ensure proper functionality.

Refer to: 5.10 Airbag Supplemental Restraint System (SRS) (page 188).
Refer to: 5.11 Seatbelt Systems (page 192).

5.9 Glass, Frames and Mechanisms

5.9.1 Heated Rear Window

WARNING: The base system should not be tampered with (controlled by body control module and multiplex architecture) and no feeds taken from the associated wiring or controller.

5.10 Airbag Supplemental Restraint System (SRS)

5.10.1 Airbags

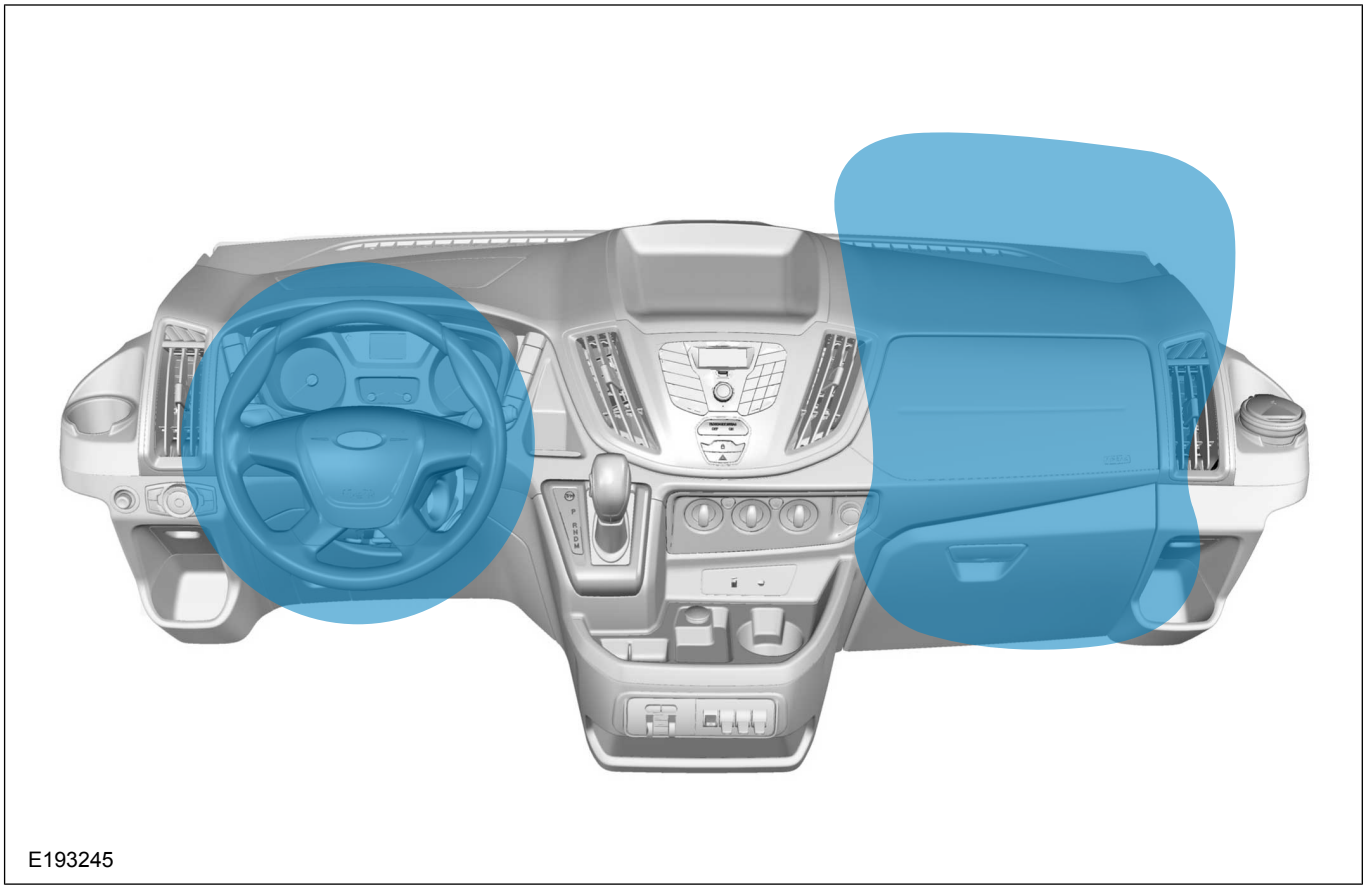
Front Airbag Deployment Zones

WARNINGS:

Do not place accessories in the deployment zone of the driver and passenger air bags as this may impair airbag deployment.

Do not place stickers or decals over the airbag covers as this may impair airbag deployment.

NOTE: Vehicles are fitted with a front passenger airbag as standard unless the front passenger seat is deleted. For vehicles with only a single row of seats, a passenger airbag deactivation switch is fitted in the glovebox. DO NOT remove or obscure the deactivation switch as this could restrict access or impair the function of the switch.



E193245

Side and Curtain Airbag Deployment Zones

WARNINGS:

Do not place accessories in the deployment zone of the side and curtain airbags as they may impair airbag deployment.

Do not place stickers or decals over the airbag covers as this may impair airbag deployment.

NOTE: All Vans get standard side seat/side curtain airbags. It is recommended to specify a base vehicle without airbags if planning modifications in this area.

For additional information on Precautionary Drill Zones

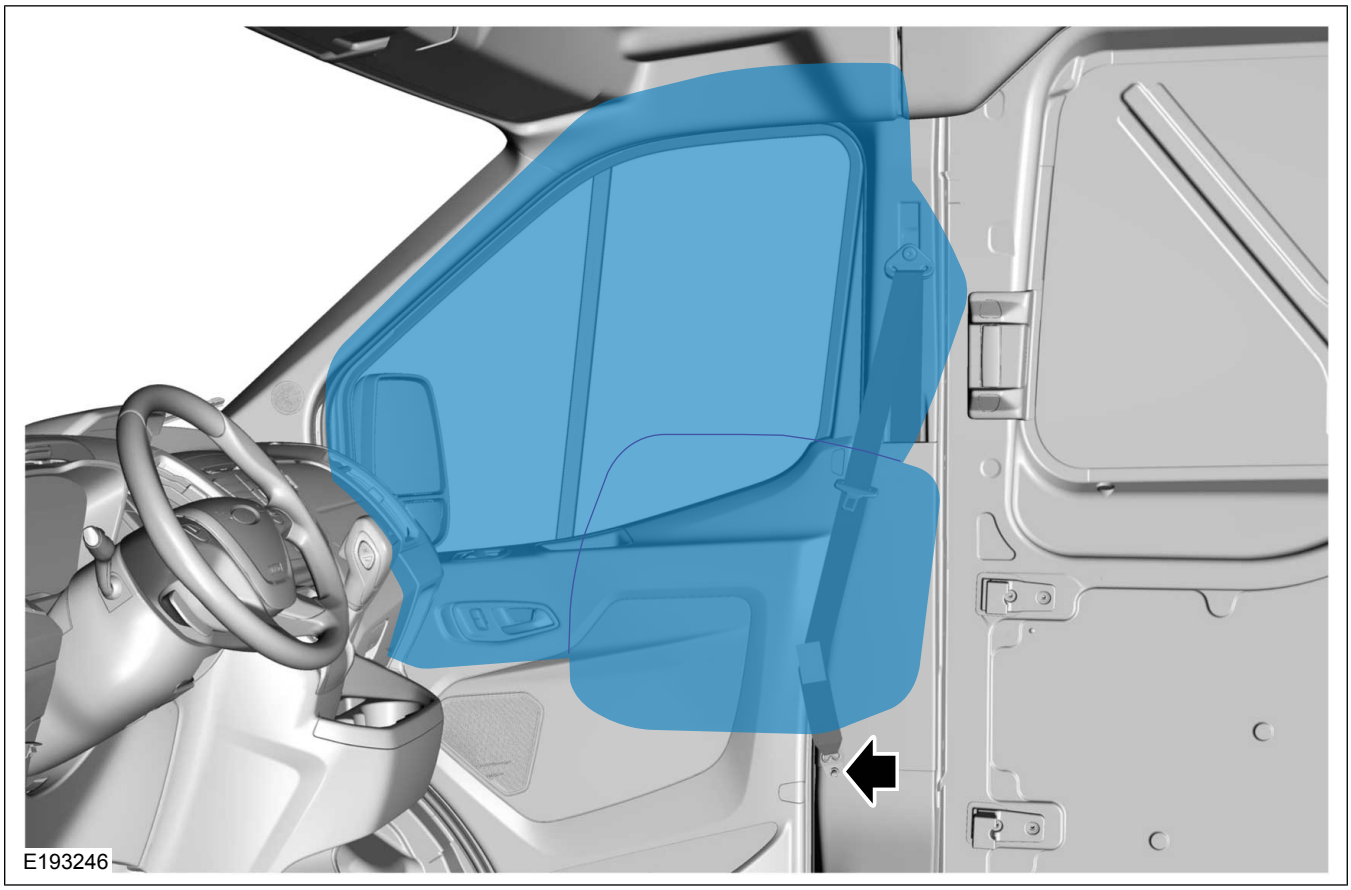
Refer to: 5.5 Body Closures (page 177).

Side Airbags (Seat Mounted): The side air bags on this vehicle have not been validated for use with swiveling front seats. Do not specify a base vehicle with side air bags if planning to retrofit a swiveling device on the front seats and/or an armrest on the outer side of the front seats; this may affect the function and/or deployment of the side airbags. Ensure any seat covers installed are designed to be used with side airbag equipped seats.

Curtain Airbags: Extensive modifications to the roof and headlining may impair deployment of the curtain airbags. If roof or headlining is to be modified or replaced, do not specify curtain airbags on the base vehicle.

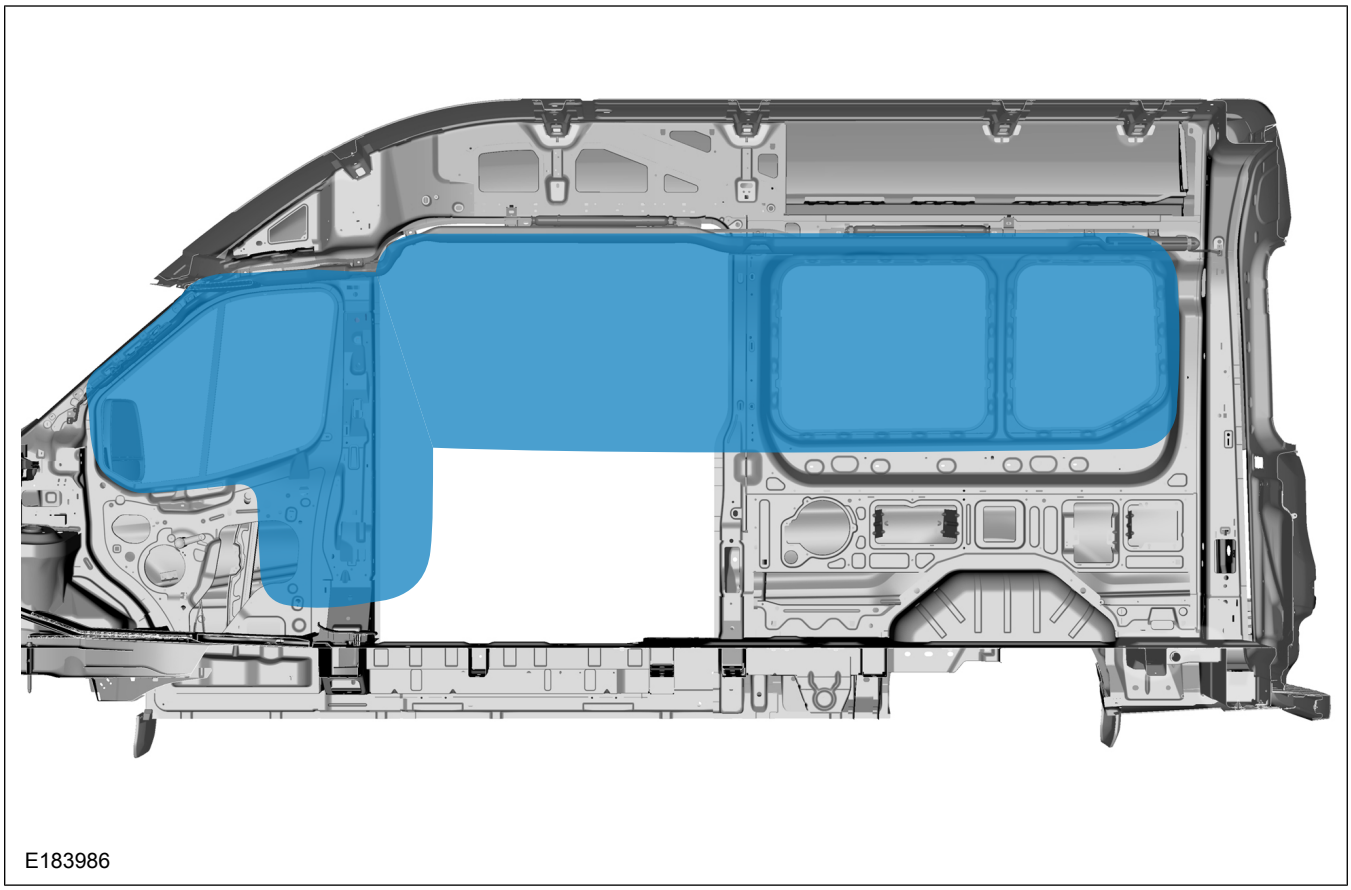
If access to the roof is required, to install roof mounted exterior accessories for example, ensure the unmodified headlining is refitted using the existing mounting points.

Front Side Curtain Airbag Deployment Zone

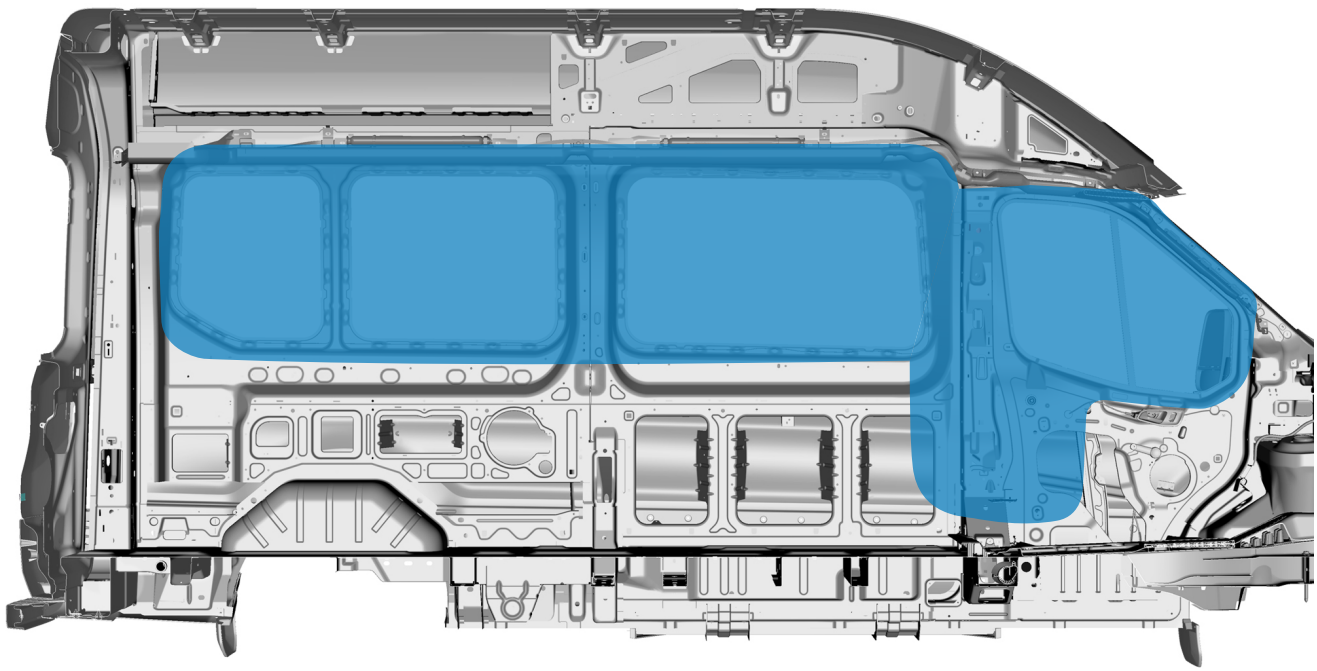


WARNING: Do not drill in Right Hand/Left Hand side retractor assy area.

Right Hand Side Curtain Airbag Deployment Zone - Wagon only



Left Hand Side Curtain Airbag Deployment Zone - Wagon only



E183987

Restraints Control Module (RCM)

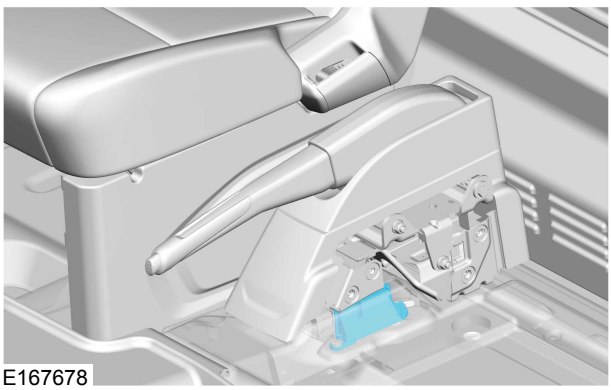
The RCM is located between the front seats , underneath the parking brake console, see figure E145413.

WARNINGS:

Modifications or reinforcements in the area of the RCM may affect the side airbag deployment timing and result in uncontrolled side airbag deployment.

The RCM device is protected by the parking brake and console to prevent damage from occupants when stepping past the seat to access the rear of the vehicle. The parking brake and console should be maintained in their fitted position to ensure protection for the RCM.

Restraints Control Module (RCM)



E167678

Front and Side Sensors

The airbag sensor for the front airbags is located behind the front grille, see figure E167679.

The sensors for the side airbags are located at the bottom of the B-pillars, see figure E145412 and in the front door see figure E167680.

Additional side airbag sensors are located under the windows on wagon variants, see figures E183988 and E183989.

WARNINGS:

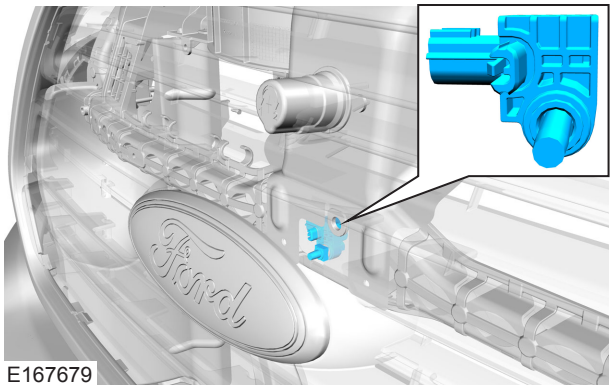
Modifications or reinforcements in the area of the sensors may affect the side air bags deployment timing and result in uncontrolled side airbag deployment.

Drilling or grinding operations in these area are only permitted when battery cables are disconnected.

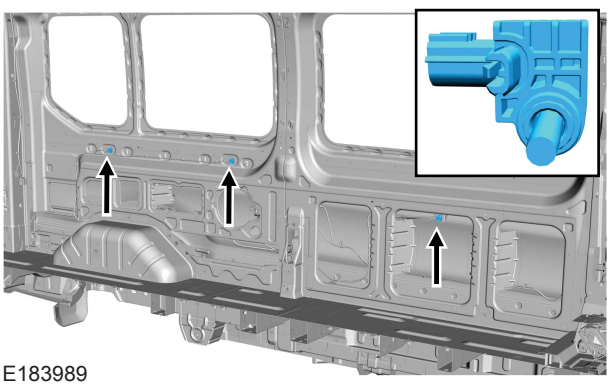
If the battery is disconnected

Refer to: 4.4 Battery and Cables (page 72).
Battery and Monitoring Sensor section for reconnecting battery.

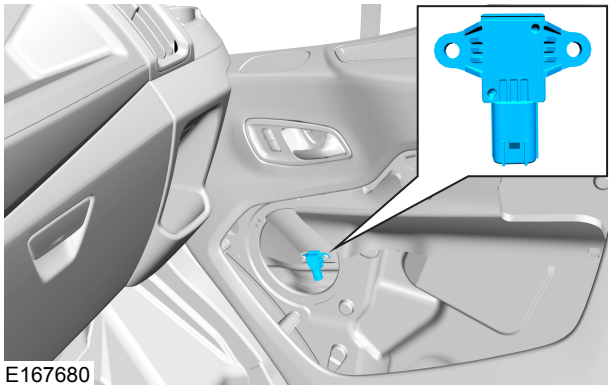
Front Sensor - All Variants



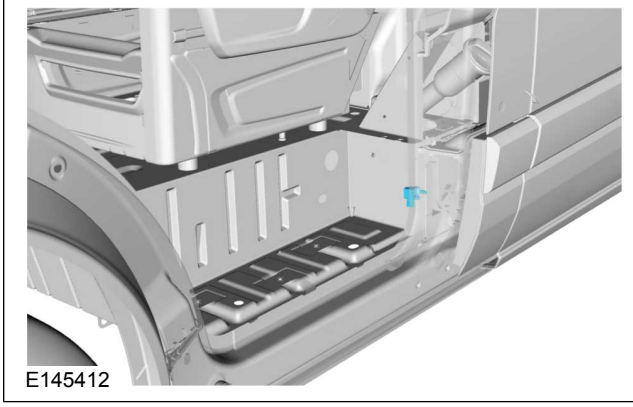
Rear Side Sensors - Wagon Left Hand Side



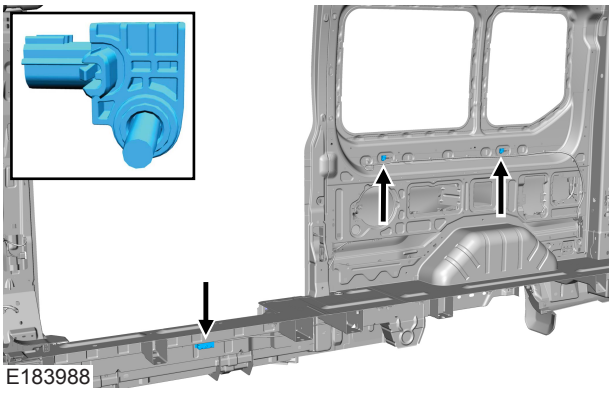
Door Sensor - All Variants



Front Side Sensor - All Variants



Rear Side Sensors - Wagon Right Hand Side



5.11 Seatbelt Systems

5.11.1 Seatbelts

WARNING: Follow removal and installation procedures for the seat belt system to ensure correct function of the restraints system.

The removal and reinstallation of the seatbelt, buckle or any component of the seatbelt system should be avoided. However if removal and re-installation of the system is required during the modification, follow the removal and installation guidelines of the seatbelt system as described in the workshop manual.

When removing the seatbelt system, a seat belt webbing forked retainer should be applied to the webbing 200mm below the webbing button stop. This prevents a situation where all the webbing runs back into the retractor and the retractor becomes locked.

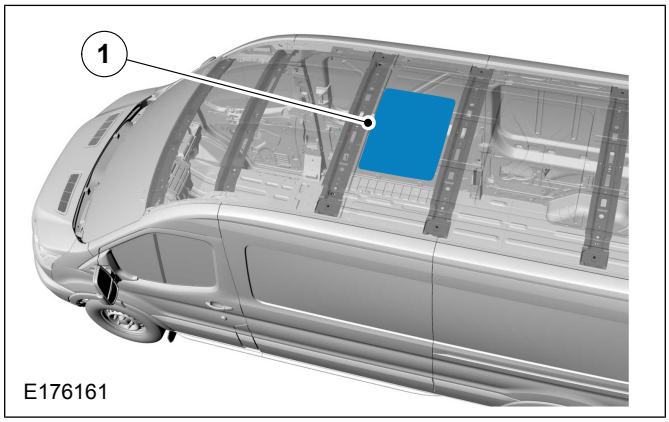
When reinstalling, fit the retractor to the body first and gently pull the webbing out of the retractor to allow fitment of the D loop. Then remove the forked retainer. If the retractor is locked, allow a small amount of webbing to reel back into the retractor to allow the webbing lock to release. Do not attempt to release the retractor by pulling on the webbing with significant force or by manually interfering with the locking mechanism.

If drilling or performing modifications inside the vehicle, the seatbelt and retractor assemblies should be covered to avoid potential debris from entering the retractor assembly. The seatbelts should be cycled to ensure correct operation following any vehicle modification.

5.11.2 Driver Belt-Minder

Driver belt-minder is a legal requirement. A switch is provided in the driver's buckle to sense the seat belt wearing status of the driver. If a vehicle is modified, this function must be retained.

5.12.1 Roof Ventilation



E176161

Item	Description
1	Roof Panel Aperture

General - Apertures must not cut through roof bows, see figure E176161. Ventilators must prevent direct entry of water and dust. A shut-off system should be available to prevent fume ingress. Interior and exterior projection legal requirements must be maintained.

Ventilation Units -The roof panel can support up to 1kg /2.2lbs on an unsupported area of roof. Loads up to a maximum of 25kg/55lbs must be distributed over the full length of the roof rails between the roof bows.

Air Conditioning Units -Units weighing more than 25kg/55lbs must be internally supported on cross brace members distributing the load out to the roof rails.

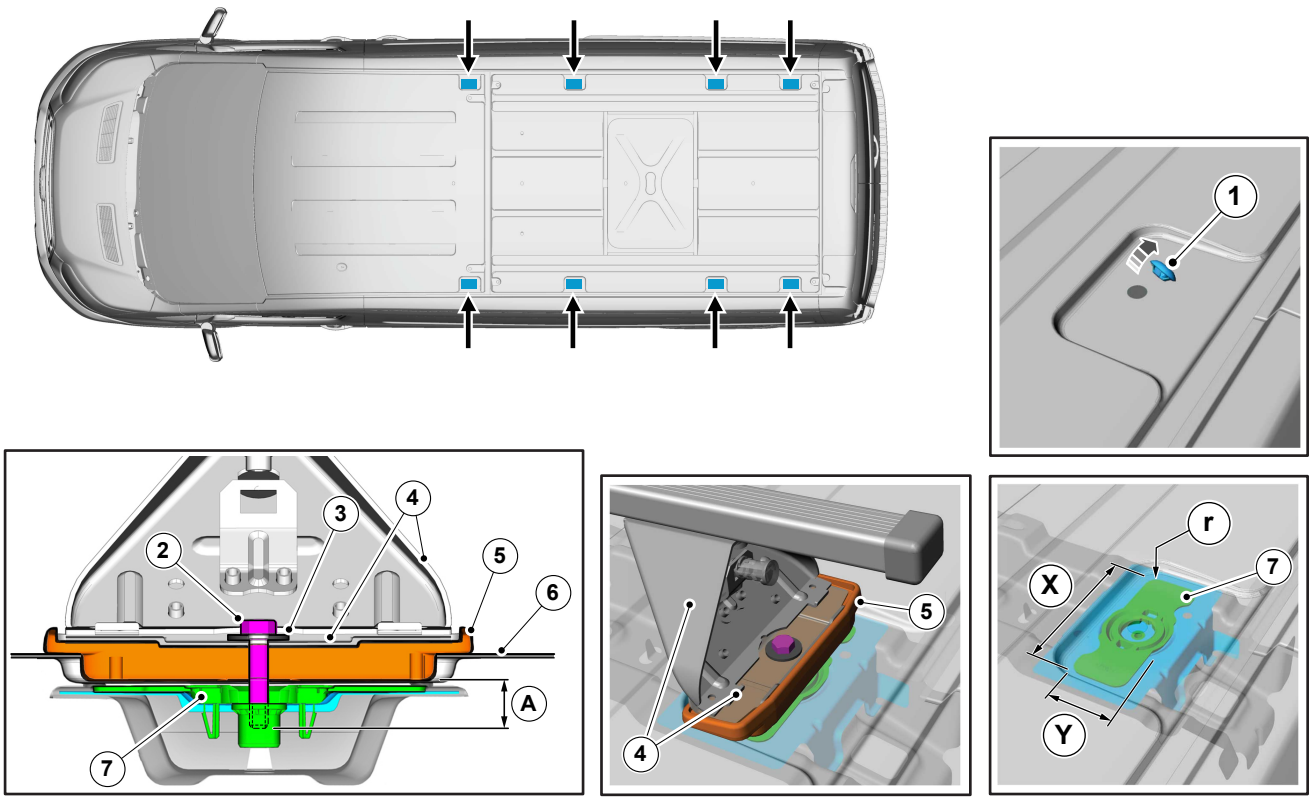
5.12.2 Roof Racks and Load Carriers

NOTE: The number of load retaining fixtures vary depending on the vehicle.

- Ideally, the bearing surface of the roof rack attached should be the same as the reinforcement inside the roof, see figure E176163, item 7 and dimensions X,Y and r
- Ensure sealing of surfaces, for example: with EPDM rubber material or equivalent and ensure sealing along the bolt for preventing water ingress into the interior of the vehicle, see figure E176163 items 3 and 5
- The thread size is M8. The maximum intrusion of the M8 bolt into the roof is 16mm/0.62 inch, see 'A' in figure E176163
- Load not to exceed 79.3kg (175lbs) at individual attachment points for local durability
- Load not to exceed 190kg (420lbs) total for roof structure durability
- Refer to: 1.12 Load Distribution (page 20). For guidance on center of gravity
- When removing the roof rack ensure holes are properly sealed with sealing plugs or equivalent water tight elements

For further information please go to the Body Builders Advisory Service, https://fordbbas.com/, or please contact bbasqa@ford.com

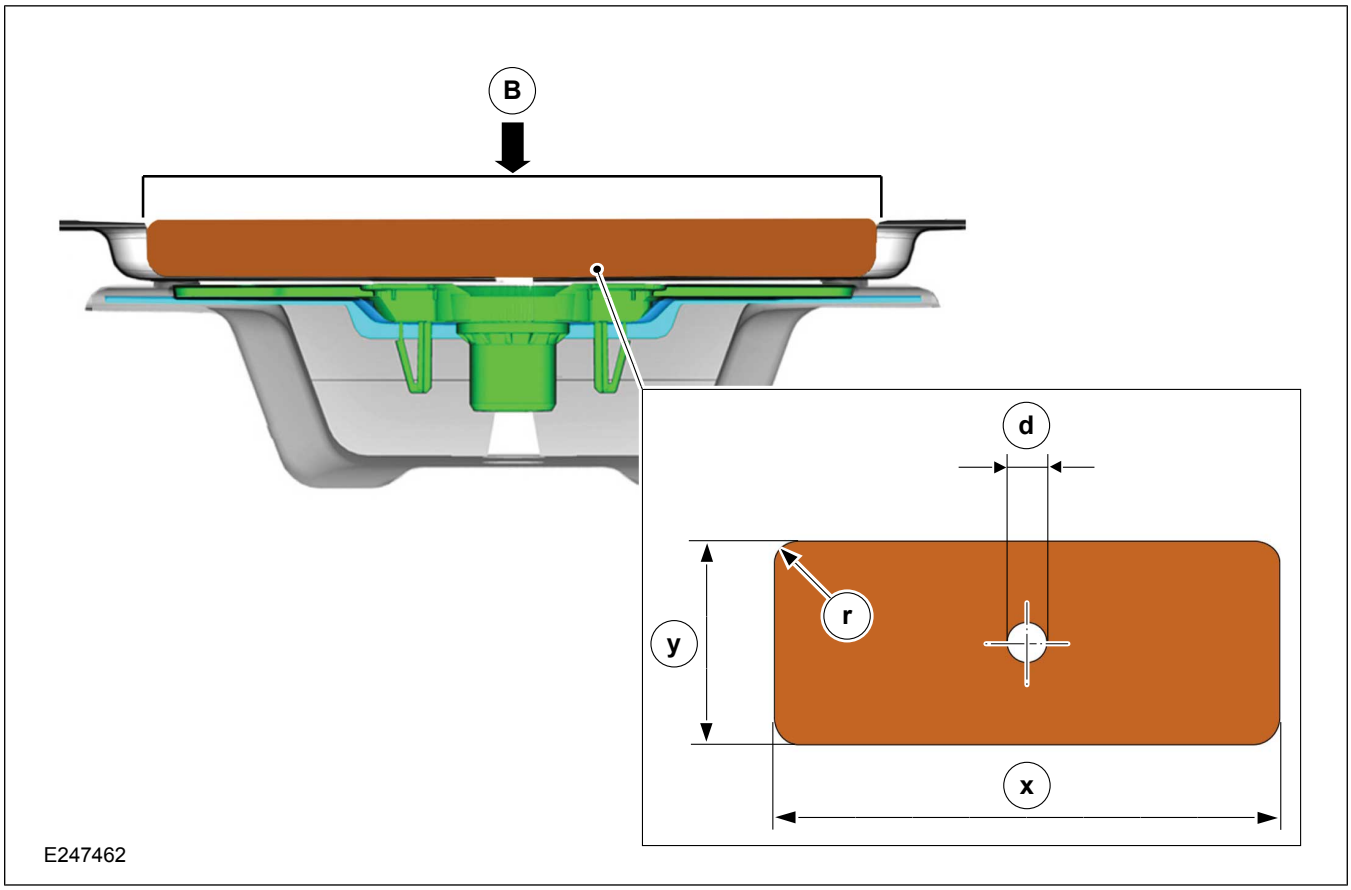
Recommended Design Principle - Load Retaining Fixtures



E176163

Item	Description
1	Plug to avoid water ingress and corrosion
2	M8 Bolt
3	Seal
4	Roof Rack System
5	Seal/Spacer (see E247462)
6	Roof Panel
7	Reinforcement
A	Maximum intrusion 0.62" (16mm)
X	5.1" (130mm)
Y	1.85" (47mm)
r	0.4" (10mm)

Recommended Spacer Dimensions



Item	Description
B	Load Bearing Surface – Lateral roof rack beams should be centered fore/aft over the roof mounting points/depressions
X	5" (127mm)
Y	2" (50.8mm)
r	0.25" (6.35mm) radius x4
d	0.394" ±0.0059" (10.00 ±0.15 mm) diameter hole (center of spacer)

NOTE: De-burr all edges.

NOTE: Avoid load application to Class A roof panel surface.

Trimline Tolerance ±/0.0197" (0.5mm)

Material Thickness Low Roof = 0.375" (9.523mm). Material Thickness Medium and High Roof = 0.56" (14.28mm).

5.13 Corrosion Prevention

5.13.1 General

Avoid drilling into closed frame body members to avoid the risk of corrosion from waste metal filings.

If drilling is required, however:

- Re-paint metal edges and protect against corrosion after cutting or drilling operations
- Endeavor to remove all waste metal filings from inside the side member and treat to prevent corrosion
- Apply corrosion protection inside and outside of the chassis frame

For Welding:

Refer to: 5.1 Body (page 155).

5.13.2 Repairing Damaged Paint

After cutting or reworking any sheet metal on the vehicle the damaged paint must be repaired.

Ensure all materials are compatible with the relevant Ford specifications and maintain the original performance where possible.

5.13.3 Under Body Protection and Material

WARNING: Do not over-coat or contaminate surfaces of components such as brakes, exhaust or catalytic modifiers.

Ensure all materials are compatible with the relevant Ford specifications and maintain the original performance where possible.

5.13.4 Painting Road Wheels

WARNING: Do not paint wheel clamp surfaces in contact with other wheels, brake drum or disc, hub and holes or surface under wheel nuts. Any further treatment in these areas may affect the wheel clamp performance and the vehicle safety. Mask the wheel when changing the color or repairing paint.

5.13.5 Contact Corrosion

When using different materials with a different electrochemical potential, ensure that materials are isolated from each other to prevent contact corrosion caused by a potential difference.

Use appropriate isolation materials. Where possible, choose materials with low level of electrochemical potential difference.

5.14 Frame and Body Mounting

5.14.1 Mounting Points and Tubing

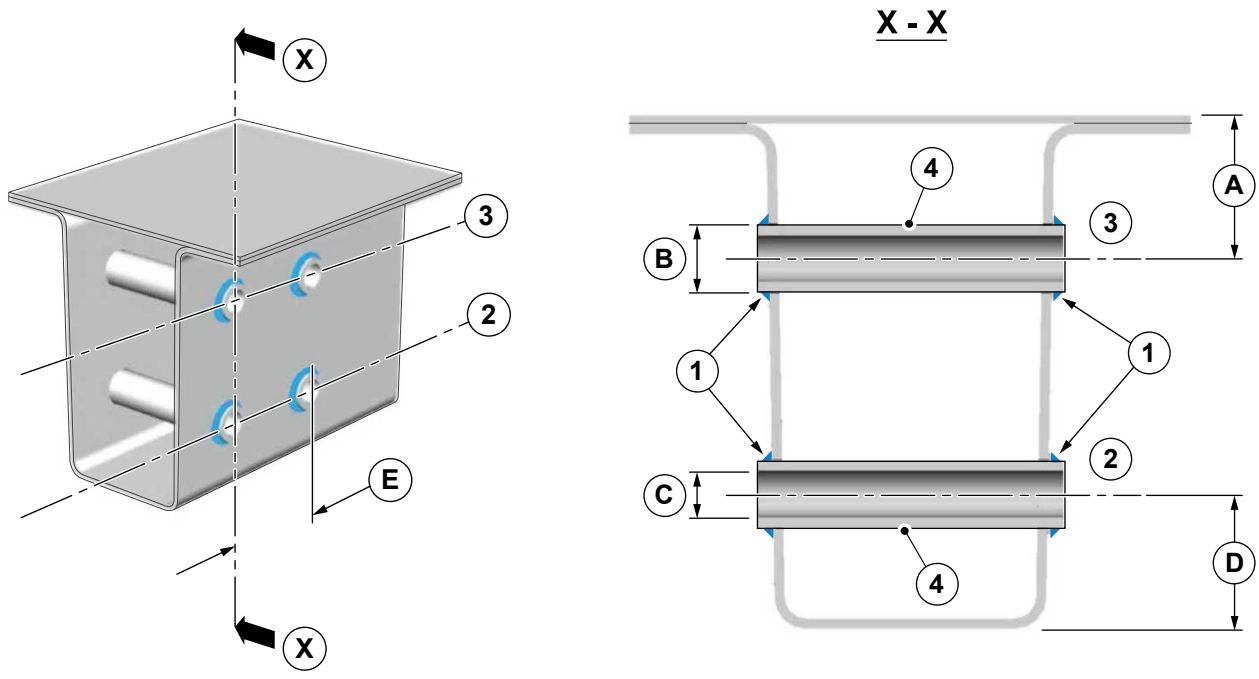
The holes on the frame are a result of the production process. They are not designed for fixing additional equipment. Tube reinforcements are required to avoid crushing of the box frame construction. If additional fixings to the chassis frame are required please follow the recommendation given in figure E192371. This does not apply to areas of load applications such as spring fixings or damper fixings.

Vehicle modifiers are responsible for added weight and design prove out.

NOTE: After drilling, deburr and countersink all holes and remove chips from the frame. Follow corrosion prevention.

Refer to: 5.13 Corrosion Prevention (page 196).

Frame Drilling and Tube Reinforcing



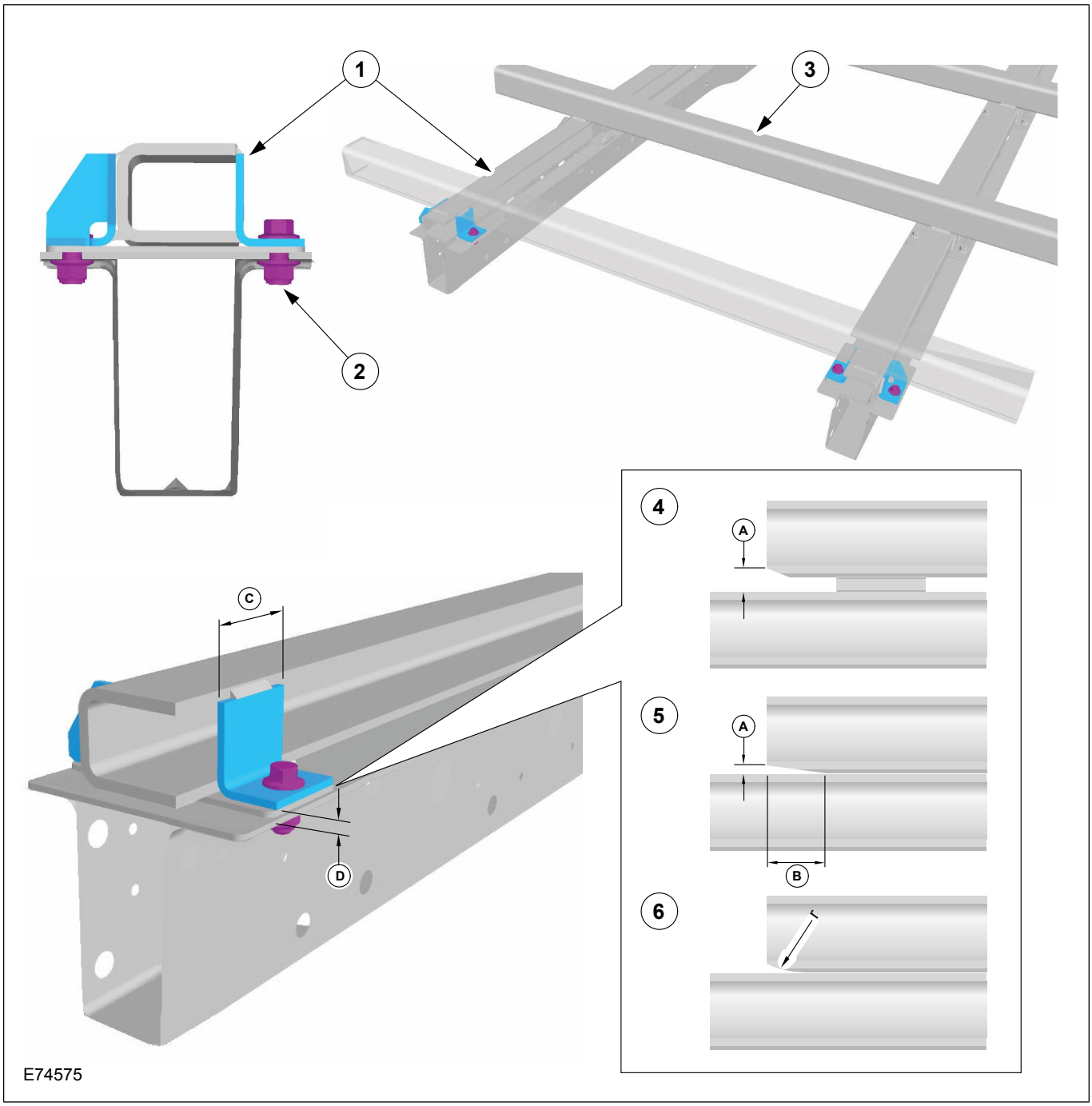
E192371

Item	Description
1	Full Penetration; Full diameter weld each side
2	Center line of holes/tubing
3	Center line of holes/tubing
A	1.18" (30mm) to 1.37" (35mm)
B	Diameter 0.65" (16.5mm) maximum
C	Diameter 0.43" (11mm)
D	1.18" (30mm) to 1.37" (35mm)
E	1.97" (50mm) minimum

It is recommended to always use a tube.

It is recommended to always use washers. Size minimum equal to lower rail width.

Sub Frame for Low Floor or other Equipment - Chassis Cab and Cutaway (Examples)



Item	Description
1	Continuous longitudinal float or body support member
2	Always use both sides of all chassis mounts
3	Cross members
4,5,6	Relief front end and longitudinal if there is a risk of stress concentration in chassis frame from longitudinal contact
A	0.2" (5mm) minimum
B	1.97" (50mm) minimum
C	1.97" (50mm) width for all brackets
D	Avoid longitudinal contact if possible which may create stress concentration
r	0.79" (20mm) minimum

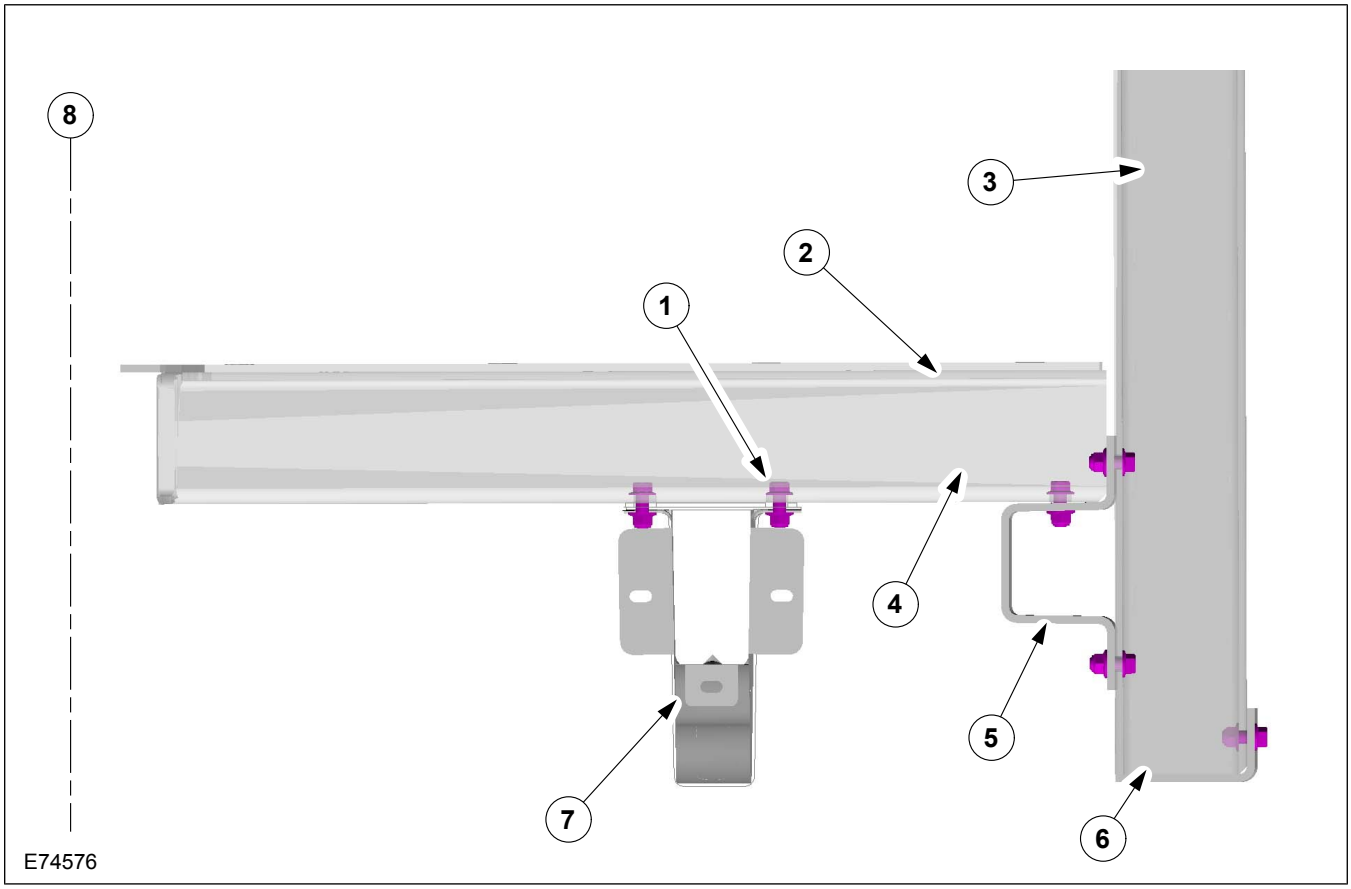
5.14.2 Self-Supporting Body Structure

Bodies and structures can be judged as self-supporting providing they maintain the following rules:

- Cross members are used at each chassis mounting point, please

  Refer to: 5.1 Body (page 155).
  - Chassis Frame Body Attachment figures E67667, E167668, 167669 and E167670 also E74576 and E176203 in this section
- Each cross member has a suitably engineered connection to the body side wall (3) or to the continuous floor frame (5), shown in figure E74576
- The body side wall or the continuous floor frame supports any overhang beyond the chassis frame, whether on standard frame or extended frame

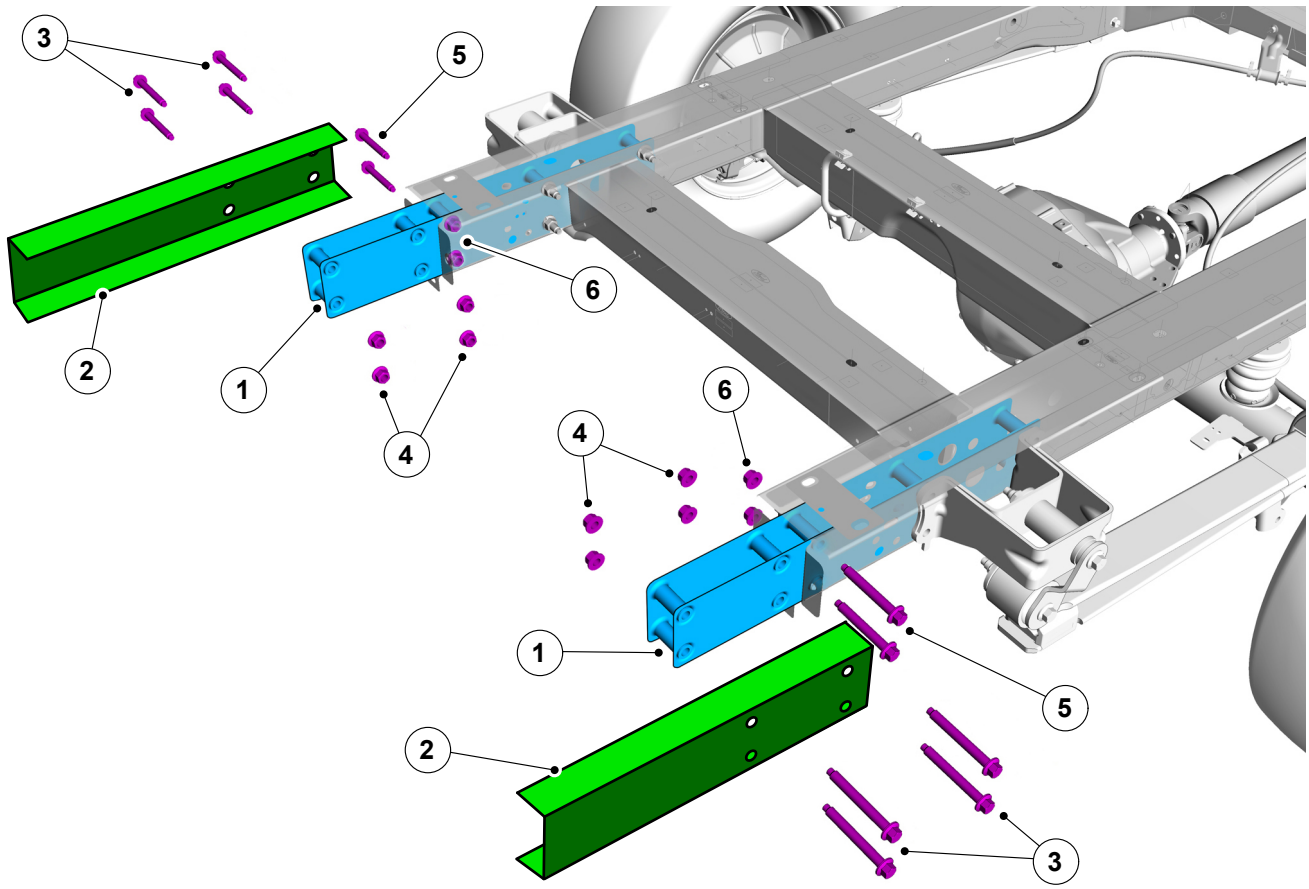
Typical Design Principle of a Self-Supporting Body Structure

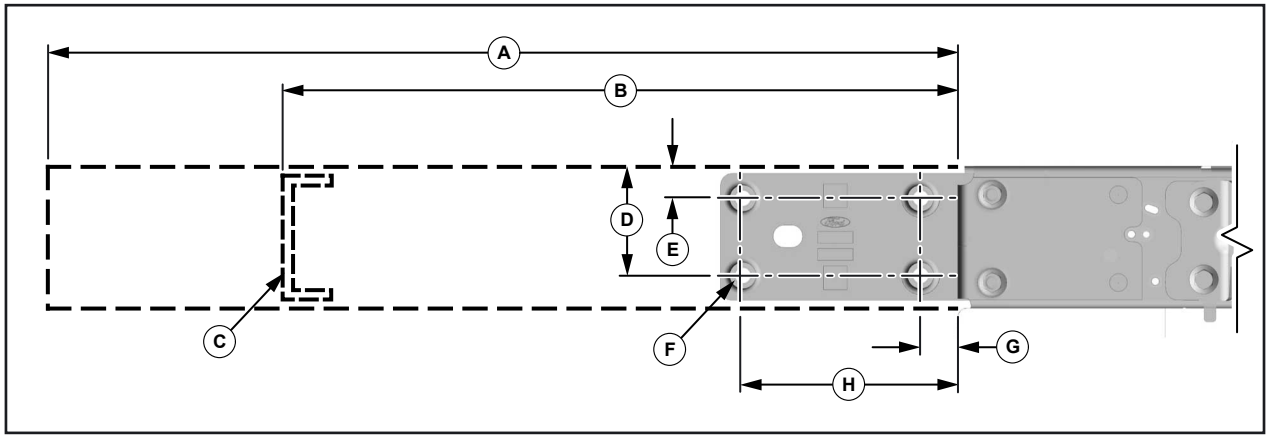


Item	Description
1	Use all standard locations with 2 x M10 fixings
2	Floor Panel
3	Body side frames
4	Floor cross members
5	Continuous floor U-profile frame
6	Longitudinal L-profile
7	Chassis frame rail of base vehicle
8	Vehicle center line of base vehicle

5.14.3 Extended Chassis Cab/Cutaway Frame

Chassis Cab/Cutaway Rear Frame Extension Adaptor





E189873

Item	Description
1	Rear Frame Extension Adaptor (supplied with vehicles)
2	'C' Channel Frame Extension (Supplied, if required, by Vehicle Modifier)
3	4 x Bolts (each side) M12 -1.75 Grade 10.9 - Torque 66.4 -76 ft-lb (90-103Nm)
4	4 x Nuts (each side) M12 - 1.75 Grade 10.9
5	2 x Bolts (each side to be retrofitted by the vehicle modifer) M12 -1.75 Grade 10.9 - Torque 66.4 -76 ft-lb (90-103Nm)
6	2 x Nuts (each side to be retrofitted by the vehicle modifer) M12 - 1.75 Grade 10.9
A	Maximum Frame Extension Length - 138"(3505mm) RWB 30" (762mm), 156" (3962mm) LWB 50" (1270mm), 178" (4521mm) ELWB 80"
B	To be determined by the Vehicle Modifier
C	Greater than 60" (1524mm) extension requires additional crossmember
D	3.72" (94.4mm)
E	1.16" (29.4mm)
F	4 holes (each Side) 0.5" (12.8mm)
G	1.23" (31.3mm)
H	7.14" (181.3mm)

General:

- Frame Extension Adaptors are supplied with vehicles.
- Bodies or equipment exceeding the standard extension length must be supported, please refer to figure E74575 low body longitudinal members or figure E74576 self-supporting body structures
- It is the vehicle modifier's responsibility to mark up the Owner's Manual advising the available payload. Axel plated weights and maximum allowable axle mass as shown in this manual must not be exceeded
- The vehicle should be planned for uniformly distributed loads

Extensions must comply with the following guidelines:

- Flat-beds and low bodies built onto Non Regular Production Option extensions must have continuous longitudinal members engineered by the Vehicle Modifier or equipment supplier, please refer to figure. E74575, to resolve the worst case moments at rear bump stop
- Extensions should be secured to the Frame Adaptor utilizing the 4 bolts and 4 holes in the rear of the Frame Adaptor, total 8 per vehicle, see figure E189873 items 3 and 4
- The Frame Adaptor should be secured to the frame utilizing the 2 bolts and 2 holes in the rear of the frame, total 4 per vehicle, see figure E189873 items 5 and 6
- Drilling of the top flanges turned out is only permissible rearward of the spring hanger brackets, for continuity of the altered extension closing plate, if required. The diameter of the holes should be 0.24" (6mm) maximum
- It is recommended that the altered extension has similar properties to the existing chassis frame
- An equivalent open section for the extension assembly is at the Vehicle Modifier discretion
- Lightening holes in new extension and cross members are discretional
- Do not weld original chassis frame except as specified when adding reinforcing tubes
- Do not drill the top or bottom surface of the chassis frame, including the flanges turned out, except as recommended above for continuity of closure
- Any alternative finish such as hot dip galvanizing is at the discretion of the Vehicle Modifier providing it does not have a detrimental effect on the original Ford product.

Refer to: 5.13 Corrosion Prevention (page 196).

5.14.4 Frame Drilling and Tube Reinforcing

The chassis frame may be drilled and reinforcing spacer tubes may be welded in place, providing the following is applied:

- Locate and drill holes accurately, using a drill guide to ensure holes are square to frame vertical center line (allow for side member draft angle)
- Drill undersize and ream out to size
- Endeavor to remove all waste metal filings from inside side member, and treat to prevent corrosion
- Fully weld each end of the tube and grind flat and square, in groups if applicable. Be aware of side member draft angle

- Apply corrosion protection inside and outside of the chassis frame.

  Refer to: 5.13 Corrosion Prevention (page 196).
- Holes should be in groups of two, either vertically spaced at 30 to 35mm from chassis frame top and/or bottom surface, or horizontally at 50mm minimum pitch, 1.18" (30mm) to 1.37" (35mm) from top and/or bottom chassis frame surface
- Always use M10 bolts with grade 8.8 minimum
- Do not position tubes at the medium chassis frame height, this may create “oil canning” of the deep section side walls
- Where possible, the outrigger moments should be resolved by matching inner cross members between the chassis side members inline with the outriggers, please refer to figure E74577
- A diameter of 0.65" (16.5mm) is the maximum allowable hole size in the chassis frame side wall, irrespective of the usage

Avoid drilling into closed frame body members to avoid the risk of corrosion from waste metal filings.

Refer to: 5.13 Corrosion Prevention (page 196).

Drilling and welding of frames and body structure have to be conducted following the guidelines.

Refer to: 5.1 Body (page 155).
Welding.

5.14.5 Ancillary Equipment - Sub Frame Mounting

Typical sub-frames and longitudinal members for flatbed and low or drop-side bodies or equipment exceeding the standard or Regular Production Order frame length should adhere to the following guidelines (not for Motorhomes):

- Flat-beds and low bodies mounted on integral longitudinal members, channel or box section metal – not wood, must use both sides of all frame mounting brackets, see figure E74575
- Longitudinal members must be relieved at the front end if they are to contact the chassis frame top surface, to minimize stress concentrations, see figure E74575. However, it is preferable to mount the longitudinal onto the mounting brackets, with a clearance to the chassis frame top surface
- Each set of brackets must use 2 x M10 bolts grade 8.8 minimum
- The rear 2 sets of chassis frame mounting holes/locations should have a full bolt torque with 100% grip. The attachment to the remaining forward chassis frame holes / locations must be precisely located and retained, but allow some relative flexing between the sub-frame and chassis frame. For example, clamp control devices such as conical washer stacks or machine springs with self locking fasteners.
- Minimum floor heights will require wheel arch boxes to clear the rear tires, see Vehicle Data sheets for relevant tire jounce
- Chassis frame, for example: clamp control devices such as conical washer stacks or machine springs with self locking fastenings
- Minimum floor heights will require wheel arch boxes to clear the rear tires

Pedestal mounted low or drop side bodies – (not illustrated)

For bodies or equipment not exceeding the standard or Regular Production Order chassis frame length.

For flat-beds and low bodies raised above the maximum “jounced” tire position to obtain an uninterrupted flat floor surface see vehicle data sheets.

- Fore and after longitudinal bracing must be added between the rear-most 2 cross members only
- All chassis frame mounting holes/locations must always be used
- All chassis frame mounting bracket fastenings must have a full bolt torque with 100% friction grip

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